ESTABLISHED BY EDWARD L. YOUMANS.

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THE

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MAY, 1890.

EDWARD LIVINGSTON YOUMANS:*

THE MAN AND HIS WORK.

By JOHN FISKE.

IN one of the most beautiful of all the shining pages of his History of the Spanish Conquest in America, Sir Arthur Helps describes the way in which, through "some fitness of the season, whether in great scientific discoveries or in the breaking into light of some great moral cause, the same processes are going on in many minds, and it seems as if they communicated with each other invisibly. We may imagine that all good powers aid the 'new light,' and brave and wise thoughts about it float aloft in the atmosphere of thought as downy seeds are borne over the fruitful face of the earth" (vol. iii, page 113). The thinker who elaborates a new system of philosophy deeper and more comprehensive than any yet known to mankind, though he may work in solitude, nevertheless does not work alone. The very fact which makes his great scheme of thought a success and not a failure is the fact that it puts into definite and coherent shape the ideas which many people are more or less vaguely and loosely entertaining, and that it carries to a grand and triumphant conclusion processes of reasoning in which many persons have already begun taking the earlier steps. This community in mental trend between the immortal discoverer and many of the brightest contemporary minds, far from diminishing the originality of his work, constitutes the feature of it which makes it a permanent acquisition for mankind, and distinguishes it from the eccentric philosophies which now and then come up to startle the world for a while, and are presently discarded and forgotten. The his-

* An Address before the Brooklyn Ethical Association, March 23, 1890.

tory of modern physics—as in the case of the correlation of forces and the undulatory theory of light—furnishes us with many instances of wise thoughts floating like downy seeds in the atmosphere until the moment has come for them to take root. And so it has been with the greatest achievement of modern thinking—the doctrine of evolution. Students and investigators in all departments, alike in the physical and in the historical sciences, were fairly driven by the nature of the phenomena before them into some hypothesis, more or less vague, of gradual and orderly change or development. The world was ready and waiting for Herbert Spencer's mighty work when it came, and it was for that reason that it was so quickly triumphant over the old order of thought. The victory has been so thorough, swift, and decisive that it will take another generation to narrate the story of it so as to do it full justice. Meanwhile, people's minds are apt to be somewhat dazed with the rapidity and wholesale character of the change; and nothing is more common than to see them adopting Mr. Spencer's ideas without recognizing them as his or knowing whence they got them. As fast as Mr. Spencer could set forth his generalizations they were taken hold of here and there by special workers, each in his own department, and utilized therein. His general system was at once seized, assimilated, and set forth with new illustrations by serious thinkers who were already groping in the regions of abstruse thought which the master's vision pierced so clearly. And thus the doctrine of evolution has come to be inseparably interfused with the whole mass of thinking in our day and generation. I do not mean to imply that people commonly entertain very clear ideas about it, for clear ideas are not altogether common. I suspect that a good many people would hesitate if asked to state exactly what Newton's law of gravitation is.

Among the men in America whose minds, between thirty and forty years ago, were feeling their way toward some such unified conception of nature as Mr. Spencer was about to set forth in all its dazzling glory—among the men who were thus prepared to grasp the doctrine of evolution at once and expound it with fresh illustrations—the first in the field was the man to whose memory we have met here this evening to pay a brief word of tribute. It is but a little while since that noble face was here with us and the tones of that kindly voice were fraught with good cheer for us. To most of you, I presume, the man Edward Livingston Youmans is still a familiar presence. There must be many here this evening who listened to the tidings of his death two years ago with a sense of personal bereavement. No one who knew him is likely ever to forget him. But for those who remember distinctly the man it may not be superfluous to recount the principal in-

cidents of his life and work. It is desirable that the story should be set forth concisely, so as to be remembered; for the work was like the man, unselfish and unobtrusive, and in the hurry and complication of modern life such work is liable to be lost from sight, so that people profit by it without knowing that such work was ever done. So genuinely modest, so utterly destitute of self-regarding impulses was our friend, that I believe it would be quite like him to chide us for thus drawing public attention to him, as he would think, with too much emphasis. But such mild reproof it is right that we should disregard; for the memory of a life so beautiful and useful is a precious possession of which mankind ought not to be deprived.

EDWARD LIVINGSTON YOUMANS was born in the town of Coeymans, Albany County, N. Y., on the 3d of June, 1821. From his father and mother, both of whom survived him, he inherited strong traits of character as well as an immense fund of vital energy, such that the failure of health a few years ago seemed (to me, at least) surprising. His father, Vincent Youmans, was a man of independent character, strong convictions, and perfect moral courage, with a quick and ready tongue, in the use of which earnestness and frankness perhaps sometimes prevailed over prudence. The mother, Catherine Scofield, was notable for balance of judgment, prudence, and tact. The mother's grandfather was Irish; and, while I very much doubt the soundness of the generalizations we are so prone to make about race characteristics, I can not but feel that for the impulsive—one had almost said explosive—warmth of sympathy, the enchanting grace and vivacity of manner, in Edward Youmans, this strain of Irish blood may have been to some extent accountable. Both father and mother belonged to the old Puritan stock of New England, and the father's ancestry was doubtless purely English. Nothing could be more honorably or characteristically English than the name. In the old feudal society the *yeoman*, like the *franklin*, was the small freeholder, owning a modest estate yet holding it by no servile tenure, a man of the common people yet no churl, a member of the state who "knew his rights and knowing dared maintain." Few indeed were the nooks and corners outside of merry England where such men flourished as the yeomen and franklins who founded democratic New England. It has often been remarked how the most illustrious of Franklins exemplified the typical virtues of his class. There was much that was similar in the temperament and disposition of Edward Youmans—the sagacity and penetration, the broad common sense, the earnest purpose veiled but not hidden by the blithe humor, the devotion to ends of wide practical value, the habit of making in the best sense the most out of life.

When Edward was but six months old, his parents moved to Greenfield, near Saratoga Springs. With a comfortable house and three acres of land, his father kept a wagon-shop and smithy. In those days, while it was hard work to wring a subsistence out of the soil or to prosper upon any of the vocations which rural life permitted, there was doubtless more independence of character and real shiftiness than in our time, when cities and tariffs have so sapped the strength of the farming country. In the family of Vincent Youmans, though rigid economy was practiced, books were reckoned to a certain extent among the necessaries of life, and the house was one in which neighbors were fond of gathering to discuss questions of politics or theology, social reform or improvements in agriculture. On all such questions Vincent Youmans was apt to have ideas of his own; he talked with enthusiasm, and was also ready to listen; and he evidently supplied an intellectual stimulus to the whole community. For a boy of bright and inquisitive mind listening to such talk is no mean source of education. It often goes much further than the reading of books. From an early age Edward Youmans seems to have appropriated all such means of instruction. He had that insatiable thirst for knowledge which is one of God's best gifts to man; for he who is born with this appetite must needs be grievously ill-made in other respects if it does not constrain him to lead a happy and useful life.

After ten years at Greenfield the family moved to a farm at Milton, some two miles distant. Until his sixteenth year Edward helped his father at farm-work in the summer and attended the district school in winter. It was his good fortune for some time to fall into the hands of a teacher who had a genius for teaching —a man who in those days of rote-learning did not care to have things learned by heart, but sought to stimulate the thinking powers of his pupils, and who in that age of canes and ferules never found it necessary to use such means of discipline, because the fear of displeasing him was of itself all-sufficient. Experience of the methods of such a man was enough to sharpen one's disgust for the excessive mechanism, the rigid and stupid manner of teaching, which characterize the ordinary school. In after-years Youmans used to say that "Uncle Good"—as this admirable pedagogue was called—first taught him what his mind was for. Through intercourse and training of this sort he learned to doubt, to test the soundness of opinions, to make original inquiries, and to find and follow clews.

But even the best of teachers can effect but little unless he finds a mind ready of itself to take the initiative. It is doubtful if men of eminent ability are ever made so by schooling. The school offers opportunities, but in such men the tendency to the

initiative is so strong that if opportunities are not offered they will somehow contrive to create them. When Edward Youmans was about thirteen years old he persuaded his father to buy him a copy of Comstock's Natural Philosophy. This book he studied at home by himself, and repeated many of the experiments with apparatus of his own contriving. When he made a centrifugal water-wheel, and explained to the men and boys of the neighborhood the principle of its revolution in a direction opposite to that of the stream which moved it, we may regard it as his earliest attempt at giving scientific lectures. It was natural that one who had become interested in physics should wish to study chemistry. The teacher (who was not "Uncle Good") had never so much as laid eyes on a text-book of chemistry; but Edward was not to be daunted by such trifles. A copy of Comstock's manual was procured, another pupil was found willing to join in the study, and this class of two proceeded to learn what they could from reading the book, while the teacher asked them the printed questions—those questions the mere existence of which in text-books is apt to show what a low view publishers take of the average intelligence of teachers! It was not a very hopeful way of studying such a subject as chemistry; but doubtless the time was not wasted, and the foundations for a future knowledge of chemistry were laid. The experience of farm-work which accompanied these studies explains the interest which in later years Mr. Youmans felt in agricultural chemistry. He came to realize how crude and primitive are our methods of making the earth yield its produce, and it was his opinion that, when men have once learned how to conduct agriculture upon sound scientific principles, farming will become at once the most wholesome and the most attractive form of human industry.

Along with the elementary studies in science there went a great deal of miscellaneous reading, mostly, it would appear, of good solid books. Apparently there was at that time no study of languages, ancient or modern. At the age of seventeen the young man had shown so much promise that it was decided he should study law, and he had already entered upon a more extensive course of preparation in an academy in Saratoga County when the event occurred which changed the whole course of his life. He had been naturally gifted with keen and accurate vision, was a good sportsman and an excellent shot with a rifle, but at about the age of thirteen there had come an attack of ophthalmia which left the eyes weak and sensitive. Perpetual reading probably increased the difficulty and hindered complete recovery. At the age of seventeen violent inflammation set in, the sight in one eye was completely lost, while in the other it grew so dim as to be of little avail. Sometimes he would be just able to find his way about the

streets, at other times the blindness was almost total, and this state of things lasted for nearly thirteen years.

This dreadful calamity seemed to make it impossible to continue any systematic course of study, and the outlook for satisfactory work of any sort was extremely discouraging. The first necessity was medical assistance, and in quest of this Mr. Youmans came in the autumn of 1839 to New York, where for the most part he spent the remainder of his life. Until 1851 he was under the care of an oculist. Under such circumstances, if a man of eager energy and boundless intellectual craving were to be overwhelmed with despondency, we could not call it strange. If he were to become dependent upon friends for the means of support, it would be ungracious if not unjust to blame him. But Edward Youmans was not made of the stuff that acquiesces in defeat. He rose superior to calamity, he won the means of livelihood, and in darkness entered upon the path to an enviable fame. At first he had to resign himself to spending weary weeks over tasks that with sound eye-sight could have been dispatched in as many days. He invented some kind of writing-machine which held his paper firmly and enabled his pen to follow straight lines at proper distances apart. Long practice of this sort gave his handwriting a peculiar character which it retained in later years. When I first saw it in 1863 it seemed almost undecipherable; but that was far from being the case, and, after I had grown used to it, I found it but little less legible than the most beautiful chirography. The strokes, gnarled and jagged as they were, had a method in their madness, and every pithy sentence went straight as an arrow to its mark.

While conquering these physical obstacles Mr. Youmans began writing for the press, and gradually entered into relations with leading newspapers which became more and more important and useful as years went on. He became acquainted with Horace Greeley, William Henry Channing, and other gentlemen who were interested in social reforms. His sympathies were strongly enlisted with the little party of abolitionists, then held in such scornful disfavor by all other parties. He was also interested in the party of temperance, which, as he and others were afterward to learn, compounded for its essential uprightness of purpose by indulging in very gross intemperance of speech and action. The disinterestedness which always characterized him was illustrated by his writing many articles for a temperance paper which could not afford to pay its contributors, although he was struggling with such disadvantages in earning his own livelihood and carrying on his scientific studies. Those were days when leading reformers believed that by some cunningly contrived alteration of social arrangements our human nature, with all its inheritance

from countless ages of brutality, can somehow be made over all in a moment, just as one would go to work with masons and carpenters and revamp a house. There are many good people who still labor under such a delusion.

Though Mr. Youmans was brought into frequent contact with reformers of this sort, it does not seem to me that his mind was ever deeply impressed with such ways of thinking. Science is teaching us that the method of evolution is that mill of God, of which we have heard, which, while it grinds with infinite efficacy, yet grinds with wearisome slowness. It was Mr. Darwin's discovery of natural selection which first brought this truth home to us; but Sir Charles Lyell had in 1830 shown how enormous effects are wrought by the cumulative action of slight and unobtrusive causes, and this had much to do with turning men's minds toward some conception of evolution. It was about 1847 that Mr. Youmans was deeply interested in the work of geologists, as well as in the nebular theory, to which recent discoveries were adding fresh confirmation. Some time before this he had read that famous book, Vestiges of Creation, and, although Prof. Agassiz truly declared that it was an unscientific book crammed with antiquated and exploded fancies, I suspect that Mr. Youmans felt that amid all the chaff there was a very sound and sturdy kernel of truth.

Among the books which Mr. Youmans projected at this time, the first was a compendious history of progress in discovery and invention; but, after he had made extensive preparations, a book was published so similar in scope and treatment that he abandoned the undertaking. Another work was a treatise on arithmetic, on a new and philosophical plan; but, when this was approaching completion, he again found himself anticipated, this time by the book of Horace Mann. This was discouraging enough, but a third venture resulted in brilliant success. We have observed the eagerness with which, as a school-boy, Mr. Youmans entered upon the study of chemistry. His interest in this science grew with years, and he devoted himself to it so far as was practicable. For a blind man to carry on the study of a science which is preeminently one of observation and experiment might seem hopeless. It was at any rate absolutely necessary to see with the eyes of others if not with his own. Here the assistance rendered by his sister was invaluable. During most of this period she served as amanuensis and reader for him. But, more than this, she kept up for some time a course of laboratory work, the results of which were minutely described to her brother and discussed with him in the evenings. The lectures of Dr. John William Draper on chemistry were also thoroughly discussed and pondered.

The conditions under which Mr. Youmans worked made it

necessary for him to consider every point with the extreme deliberation involved in framing distinct mental images of things and processes which he could not watch with the eye. It was hard discipline, but he doubtless profited from it. Nature had endowed him with an unusually clear head, but this enforced method must have made it still clearer. One of the most notable qualities of his mind was the absolute luminousness with which he saw things and the relations among things. It was this quality that made him so successful as an expounder of scientific truths. In the course of his pondering over chemical facts which he was obliged to take at second hand, it occurred to him that most of the pupils in common schools who studied chemistry were practically no better off. It was easy enough for schools to buy text-books, but difficult for them to provide laboratories and apparatus; and it was much easier withal to find teachers who could ask questions out of a book than those who could use apparatus if provided. It was customary, therefore, to learn chemistry by rote; or, in other words, pupils' heads were crammed with unintelligible statements about things with queer names—such as manganese or tellurium—which they had never seen, and would not know if they were to see them. It occurred to Mr. Youmans that, if visible processes could not be brought before pupils, at any rate the fundamental conceptions of chemistry might be made clear by means of diagrams. He began devising diagrams in different colors, to illustrate the diversity in the atomic weights of the principal elements, and the composition of the more familiar compounds. At length, by uniting his diagrams, he obtained a comprehensive chart exhibiting the outlines of the whole scheme of chemical combination according to the binary or dualist theory then in vogue. This chart, when published, was a great success. It not only facilitated the acquirement of clear ideas, but it was suggestive of new ideas. It proved very popular, and kept the field until the binary theory was overthrown by the modern doctrine of substitution, which does not lend itself so readily to graphic treatment.

The success of the chemical chart led to the writing of a text-book of chemistry. This laborious work was completed in 1851, when Mr. Youmans was thirty years old. Prof. Silliman was then regarded as one of our foremost authorities in chemistry, but it was at once remarked of the new book that it showed quite as thorough a mastery of the whole subject of chemical combination as Silliman's. It was a text-book of a kind far less common then than now. There was nothing dry about it. The subject was presented with beautiful clearness, in a most attractive style. There was a firm grasp of the philosophical principles underlying chemical phenomena, and the meaning and functions of the sci-

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The publication of this book at once established its author's reputation as a scientific writer, and in another way it marked an era in his life. The long, distressing period of darkness now came to an end. Sight was so far recovered in one eye that it became possible to go about freely, to read, to recognize friends, to travel, and make much of life. I am told that his face had acquired an expression characteristic of the blind, but that expression was afterward completely lost. When I knew him it would never have occurred to me that his sight was imperfect, except perhaps as regards length of range.

Mr. Youmans's career as a scientific lecturer now began. His first lecture was the beginning of a series on the relations of organic life to the atmosphere. It was illustrated with chemical apparatus, and was given in a private room in New York to an audience which filled the room. Probably no lecturer ever faced his first audience without some trepidation, and Mr. Youmans had not the main-stay and refuge afforded by a manuscript, for his sight was never good enough to make such an aid available for his lectures. At first the right words were slow in finding their way to those ready lips, and his friends were beginning to grow anxious, when all at once a happy accident broke the spell. He was remarking upon the characteristic instability of nitrogen, and pointing to a jar of that gas on the table before him, when some fidgety movement of his knocked the jar off the table. He improved the occasion with one of his quaint *bons mots*, and, as there is nothing that greases the wheels of life like a laugh, the lecture went on to a successful close.

This was the beginning of a busy career of seventeen years of lecturing, ending in 1868; and I believe it is safe to say that few things were done in all those years of more vital and lasting benefit to the American people than this broadcast sowing of the seeds of scientific thought in the lectures of Edward Youmans. They came just at the time when the world was ripe for the doctrine of evolution, when all the wondrous significance of the trend of scientific discovery since Newton's time was beginning to burst upon men's minds. The work of Lyell in geology, followed at length in 1859 by the Darwinian theory; the doctrine of the correlation of forces and the consequent unity of nature; the extension and reformation of chemical theory; the simultaneous advance made in sociological inquiry, and in the conception of the

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true aims and proper methods of education—all this made the period a most fruitful one for the peculiar work of such a teacher as Youmans. The intellectual atmosphere was charged with conceptions of evolution. Mr. Youmans had arrived at such conceptions in the course of his study of the separate lines of scientific speculation which were now about to be summed up and organized by Herbert Spencer into that system of philosophy which marks the highest point to which the progressive intelligence of mankind has yet attained. In the field of scientific generalization upon this great scale, Mr. Youmans was not an originator; but his broadly sympathetic and luminous mind moved on a plane so near to that of the originators that he seized at once upon the grand scheme of thought as it was developed, made it his own, and brought to its interpretation and diffusion such a happy combination of qualities as one seldom meets with. The ordinary popularizer of great and novel truths is a man who comprehends them but partially and illustrates them in a lame and fragmentary way. But it was the peculiarity of Mr. Youmans that, while on the one hand he could grasp the newest scientific thought so surely and firmly that he seemed to have entered into the innermost mind of its author, on the other hand he could speak to the general public in a convincing and stimulating way that had no parallel. This was the secret of his power, and there can be no question that his influence in educating the American people to receive the doctrine of evolution was great and wide-spread.

The years when Mr. Youmans was traveling and lecturing were the years when the old lyceum system of popular lectures was still in its vigor. The kind of life led by the energetic lecturer in those days was not that of a Sybarite, as may be seen from a passage in one of his letters: "I lectured in Sandusky, and had to get up at five o'clock to reach Elyria; I had had but very little sleep. To get from Elyria to Pittsburg I must take the five o'clock morning train, and the hotel darkey said he would *try* to awaken me. I knew what that meant, and so did not get a single wink of sleep that night. Rode all day to Pittsburg, and had to lecture in the great Academy of Music over foot-lights. . . . The train that left for Zanesville departed at two in the morning. I had been assured a hundred times (for I asked everybody I met) that I would get a sleeping-car to Zanesville, and, when I was all ready to start, I was informed that *this* morning there was no sleeping-car. By the time I reached here I was pretty completely used up."

Such a fatiguing life, however, has its compensations. It brings the lecturer into friendly contact with the brightest minds among his fellow-countrymen in many and many places, and en-

larges his sphere of influence in a way that is not easy to estimate. Clearly an earnest lecturer, of commanding intelligence and charming manner, with a great subject to teach, must have an opportunity for sowing seeds that will presently ripen in a change of opinion or sentiment, in an altered way of looking at things on the part of whole communities. No lecturer has ever had a better opportunity of this sort than Edward Youmans, and none ever made a better use of his opportunity. His gifts as a talker were of the highest order. The commonest and plainest story, as told by Edward Youmans, had all the breathless interest of the most thrilling romance. Absolutely unconscious of himself, simple, straightforward, and vehement, wrapped up in his subject, the very embodiment of faith and enthusiasm, of heartiness and good cheer, it was delightful to hear him. And when we join with all this his unfailing common sense, his broad and kindly view of men and things, and the delicious humor that kept flashing out in quaint, pithy phrases such as no other man would have thought of, and such as are the despair of any one trying to remember and quote them, we can seem to imagine what a power he must have been with his lectures.

When such a man goes about for seventeen years, teaching scientific truths for which the world is ripe, we may be sure that his work is great, albeit we have no standard whereby we can exactly measure it. In hundreds of little towns with queer names did this strong personality appear and make its way and leave its effects in the shape of new thoughts, new questions, and enlarged hospitality of mind, among the inhabitants. The results of all this are surely visible to-day. In no part of the English world has Herbert Spencer's philosophy met with such a general and cordial reception as in the United States. This may, no doubt, be largely explained by a reference to general causes; but as it is almost always necessary, along with our general causes, to take into the account some personal influence, so it is in this case. It is safe to say that among the agencies which during the past fifty years have so remarkably broadened the mind of the American people, very few have been more potent than the gentle and subtle but pervasive work done by Edward Youmans with his lectures, and to this has been largely due the hospitable reception of Herbert Spencer's ideas.

It was in 1856 that Mr. Youmans fell in with a review of Spencer's Principles of Psychology, by Dr. Morell, in the Medico-Chirurgical Review. This review impressed him so deeply that he at once sent to London for a copy of the book, which had been published in the preceding year. It will be observed that this was four years before the Darwinian theory was announced to the world in the first edition of the Origin of Species. Toward the

end of that book Mr. Darwin looked forward to a distant future when the conception of gradual development might be applied to the phenomena of conscious intelligence. He had not then learned of the existence of such a book as the Principles of Psychology. In later editions he was obliged to modify his statement and confess that, instead of looking so far forward, he had better have looked about him. I have more than once heard Mr. Darwin laugh merrily over this, at his own expense.

After struggling for a while with the weighty problems of this book—the most profound treatise upon mental phenomena that any human mind has ever produced—Mr. Youmans saw that the theory expounded in it was a long stride in the direction of a general theory of evolution. His interest in this subject received a new and fresh stimulus. He read Social Statics, and began to recognize Mr. Spencer's hand in the anonymous articles in the quarterlies in which he was then announcing and illustrating various portions or segments of his newly discovered law of evolution. One evening in February, 1860, as Mr. Youmans was calling at a friend's house in Brooklyn, the Rev. Samuel Johnson, of Salem, handed him the famous prospectus of the great series of philosophical works which Mr. Spencer proposed to issue by subscription. Mr. Johnson had obtained this from Edward Silsbee, who was one of the very first Americans to become interested in Spencer. The very next day Mr. Youmans wrote a letter to Mr. Spencer, offering his aid in procuring American subscriptions and otherwise aiding in every possible way the progress of the enterprise. With this letter and Mr. Spencer's cordial reply began the life-long friendship between the two men. It was in that same month that I first became aware of Mr. Spencer's existence, through a single paragraph quoted from him by Mr. Lewes, and in that paragraph there was immense fascination. I had been steeping myself in the literature of modern philosophy, starting with Bacon and Descartes, and was then studying Comte's Philosophie Positive, which interested me as suggesting that the special doctrines of the several sciences might be organized into a general body of doctrine of universal significance. Comte's work was crude and often wildly absurd, but there was much in it that was very suggestive. In May, 1860, in the Old Corner Bookstore in Boston, I fell upon a copy of that same prospectus of Mr. Spencer's works, and read it with exulting delight, for clearly there was to be such an organization of scientific doctrine as the world was waiting for. It appeared that there was some talk of Ticknor & Fields undertaking to conduct the series in case subscriptions enough should be received. Mr. Spencer preferred to have his works appear in Boston; but when in the course of 1860 his book on Education was offered to Ticknor & Fields, they declined

to publish it, which was, of course, a grave mistake from the business point of view. Mr. Youmans, however, was not sorry for this, for it gave him the opportunity to place Mr. Spencer's books where he could do most to forward their success.

Some years before, during his blindness, his sister had led him one day into the store of Messrs. D. Appleton & Co. in quest of a book, and Mr. William H. Appleton had become warmly interested in him. I believe the firm now look back to this chance visit as one of the most auspicious events in their annals. He became by degrees a kind of adviser as regarded matters of publication, and it was largely through his far-sighted advice that the Appletons entered upon the publication of such books as those of Buckle, Darwin, Huxley, Tyndall, Haeckel, and others of like character, always paying a royalty to the authors, the same as to American authors, in spite of the absence of an international copyright law. As publishers of books of this sort the Appletons have come to be pre-eminent. It is obvious enough nowadays that such books are profitable from a business point of view. But thirty years and more ago this was by no means obvious. We were very provincial. Reprints of English books, translations from French and German, were sadly behind the times. In the Connecticut town where I lived people would begin to wake up to the existence of some great European book or system of thought after it had been before the world anywhere from a dozen to fifty years. In those days, therefore, it required some boldness to undertake the reprinting of new scientific books, and none have recognized more freely than the Appletons the importance of the part played by Mr. Youmans in this matter. His work as adviser to a great publishing house and his work as lecturer re-enforced each other, and thus his capacity for usefulness was much increased.

When Mr. Spencer's book on Education failed to find favor in Boston, the Appletons took it, and thus presently secured the management of the philosophical series. This brought Mr. Youmans into permanent relations with Mr. Spencer and his work. In 1861 Mr. Youmans was married, and in the course of the following year made a journey in Europe with his wife. It was now that he became personally acquainted with Mr. Spencer, and found him quite as interesting and admirable as his books. Friendships were also begun with Huxley and other foremost men of science. From more than one of these men I have heard the warmest expressions of personal affection for Mr. Youmans, and of keen appreciation of the aid that they have obtained in innumerable ways from his intelligent and enthusiastic sympathy. But no one else got so large a measure of this support as Mr. Spencer. As fast as his books were republished, Mr. Youmans

wrote reviews of them, and by no means in the usual perfunctory way; his reviews and notices were turned out by the score, and scattered about in the magazines and newspapers where they would do the most good. Whenever he found another writer who could be pressed into the service, he would give him Spencer's books, kindle him with a spark from his own magnificent enthusiasm, and set him to writing for the press. The most indefatigable vender of wares was never more ruthlessly persistent in advertising for lucre's sake than Edward Youmans in preaching in a spirit of the purest disinterestedness the gospel of evolution. As long as he lived, Mr. Spencer had upon this side of the Atlantic an *alter ego* ever on the alert with vision like that of a hawk for the slightest chance to promote his interests and those of his system of thought.

Among the allies thus enlisted at that early time were Mr. George Ripley and Rev. Henry Ward Beecher, both of whom did good service, in their different ways, in awakening public interest in the doctrine of evolution. In those days of the civil war it was especially hard to keep up the list of subscribers in an abstruse philosophical publication of apparently interminable length. Mr. Youmans now and then found it needful to make a journey in the interests of the work, and it was on one of these occasions, in November, 1863, that I made his acquaintance. I had already published, in 1861, an article in one of the quarterly reviews in which Mr. Spencer's work was referred to; and another in 1863, in which the law of evolution was illustrated in connection with certain problems of the science of language. The articles were anonymous, as was then the fashion, and Mr. Youmans's curiosity was aroused. There were so few people then who had any conception of what Mr. Spencer's work meant, that they could have been counted on one's fingers. At that time I knew of only three —the late Prof. Gurney, of Harvard; Mr. George Roberts, now an eminent patent lawyer in Boston; and Mr. John Clark, now of the Prang Educational Company. I have since known that there were at least two or three others about Boston, among others, my learned friend the Rev. W. R. Alger, besides several in other parts of the country. When we sometimes ventured to observe that Mr. Spencer's work was as great as Newton's, and that his theory of evolution was going to remodel human thinking upon all subjects whatever, people used to stare at us and take us for idiots. Any one member of such a small community was easy to find; and I have always dated a new era in my life from the Sunday afternoon when Mr. Youmans came to my room in Cambridge. It was the beginning of a friendship such as hardly comes but once to a man. At that first meeting I knew nothing of him except that he was the author of a text-book of chemistry

which I had found interesting, in spite of its having been crammed down my throat by an old-fashioned memorizing teacher who, I am convinced, never really knew so much as the difference between oxygen and antimony. At first it was a matter of breathless interest to talk with a man who had seen Herbert Spencer. But one of the immediate results of this interview was the beginning of my own correspondence with Mr. Spencer, which led to manifold results. And from that time forth it always seemed as if, whenever any of the good or lovely things of life came to my lot, somehow or other Edward Youmans was either the cause of it or at any rate intimately concerned with it. The sphere of his unselfish goodness was so wide and its quality so potent that one could not come into near relations with him without becoming in all manner of unsuspected ways strengthened and enriched.

In the autumn of 1865 we were dismayed by the announcement that Mr. Spencer would no longer be able to go on issuing his works. In London they were published at his own expense and risk, and those books which now yield a handsome profit did not then pay the cost of making them. By the summer of 1865 there was a balance of £1,100 against Mr. Spencer, and his property was too small to admit of his going on and losing at such a rate. As soon as this was known, John Stuart Mill begged to be allowed to assume the entire pecuniary responsibility of continuing the publication; but this, Mr. Spencer, while deeply affected by such noble sympathy, would not hear of. He consented, however, with great reluctance, to the attempt of Huxley and Lubbock, and other friends, to increase artificially the list of subscribers by inducing people to take the work just in order to help support it. But after several months the sudden death of Mr. Spencer's father added something to his means of support, and he thereupon withdrew his consent to this arrangement, and determined to go on publishing as before, and bearing the loss.

But, as soon as the first evil tidings reached America, Mr. Youmans made up his mind that $5,500 must be forthwith raised by subscription, in order to make good the loss already incurred. It is delightful to remember the vigor with which he took hold of this work. The sum of $7,000 was raised and invested in American securities in Mr. Spencer's name. If he did not see fit to accept these securities, they would go without an owner. The best Waltham watch that could be procured was presented to Mr. Spencer by his American friends; a letter, worded with rare delicacy and tact, was written by the late Robert Minturn; and Mr. Youmans sailed for England to convey the letter and the watch to Mr. Spencer. It was a charming scene on a summer day in an English garden when the great philosopher was apprised of what had

been done. It was so skillfully managed that he could not refuse the tribute without seeming churlish. He therefore accepted it, and applied it to extending his researches in descriptive sociology.

Of the many visits which Mr. Youmans made to England, now and then extending them to the Continent, one of the most important was in 1871, for the purpose of establishing the International Scientific Series. This was a favorite scheme of Mr. Youmans. He realized that popular scientific books, adapted to the general reader, are apt to be written by third-rate men who do not well understand their subject; they are apt to be dry or superficial or both. No one can write so good a popular book as the master of a subject, if he only has a fair gift of expressing himself and keeps in mind the public for which he is writing. The master knows what to tell and what to omit, and can thus tell much in a short compass and still make it interesting; moreover, he avoids the inaccuracies which are sure to occur in second-hand work. Masters of subjects are apt, however, to be too much occupied with original research to write popular books. It was Mr. Youmans's plan to induce the leading men of science in Europe and America to contribute small volumes on their special subjects to a series to be published simultaneously in several countries and languages. Furthermore, by special contract with publishing houses of high reputation, the author was to receive the ordinary royalty on every copy of his book sold in every one of the countries in question, thus anticipating international copyright upon a very wide scale, and giving the author a much more adequate compensation for his labor. To put this scheme into operation was a task of great difficulty, so many conflicting interests had to be considered. Mr. Youmans's brilliant success is attested by that noble series of more than fifty volumes, on all sorts of scientific subjects, written by men of real eminence, and published in England, France, Italy, Germany, and Russia, as well as in the United States.

A word is all that can be spared for other parts of our friend's work, which deserve many words and those carefully considered. His book on Household Science is not the usual collection of scrappy comment, recipe, and apothegm, but a valuable scientific treatise on heat, light, air, and food in their relations to everyday life. In his Correlation of Physical Forces he brings together the epoch-making essays of the men who have successively established that doctrine, introducing them with an essay of his own in which its history and its philosophical implications are set forth in a masterly manner. In his book on the Culture demanded by Modern Life we have a similar collection of essays with a similar excellent original discussion, showing the need for wider and later training in science, and protesting against the excess of time

and energy that is spent in classical education where it is merely the following of an old tradition.

As a crown to all this useful work Mr. Youmans established, in 1872, The Popular Science Monthly, which has unquestionably been of high educational value to the general public. It was not the aim of this magazine to give an account of every theory expounded, every fact observed, every discovery made from year to year, whether significant or insignificant. The mind of the people is not educated by dumping a great, unshapely mass of facts into it. It needs to be stimulated rather than crammed. Education in science should lead one to think for one's self. The scientific magazine, therefore, should present articles from all quarters that deal with the essential conceptions of science or discuss problems of real theoretical or practical interest, no matter whether every particular asteroid or the last new species of barnacle receives full attention or not. The Popular Science Monthly has now been with us eighteen years; its character has always been of the highest, and it must have exerted an excellent influence not only as a diffuser of valuable knowledge, but in training its readers to scientific habits of thought in so far as mere reading can contribute to such a result.

In concluding our survey of this useful and noble life, what impresses us most, I think, is the broad, democratic spirit and the absolute unselfishness which it reveals at every moment and in every act. To Edward Youmans the imperative need for educating the great mass of the people so as to use their mental powers to the best advantage came home as a living, ever-present fact. He saw all that it meant and means in the raising of mankind to a higher level of thought and action than that upon which they now live. To this end he consecrated himself with unalloyed devotion; and we who mourn his loss look back upon his noble career with a sense of victory, knowing how the good that such a man does lives after him and can never die.

[Mr. Fiske's address was followed by appreciative remarks from several gentlemen who had known Mr. Youmans, and who gave many interesting reminiscences of him. We append a letter from Mr. Spencer, which arrived too late to be read at this meeting.]

64 AVENUE ROAD, REGENT'S PARK, LONDON, N. W., *March* 18, 1890.

DEAR MR. SKILTON: I received your telegram last night, and from the wording conclude that you wish some letter from me about Youmans which Fiske may read in his lecture on the 23d. I am very glad to respond to the request, and I can not do this better than by giving you the following copy of a passage in my Autobiography concerning him:

"The relation thus initiated was extremely fortunate; for

Prof. Edward L. Youmans was, of all Americans I have known or heard of, the one most able and most willing to help me. Alike intellectually and morally, he had in the highest degrees the traits conducive to success in diffusing the doctrines he espoused; and from that time to this he has devoted his life mainly to spreading throughout the United States the doctrine of evolution. His love of wide generalizations had been shown years before in lectures on such topics as the correlation of the physical forces; and from those who heard him I have gathered that, aided by his unusual powers of exposition, the enthusiasm which contemplation of the larger truths of science produced in him was in a remarkable degree communicated to his hearers. Such larger truths I have on many occasions observed are those which he quickly seizes—ever passing at once through details to lay hold of essentials; and, having laid hold of them, he clearly sets them forth afresh in his own way with added illustrations. But it is morally even more than intellectually that he has proved himself a true missionary of advanced ideas. Extremely energetic—so energetic that no one has been able to check his overactivity—he has expended all his powers in advancing what he holds to be the truth; and not only his powers but his means. It has proved impossible to prevent him from injuring himself in health by his exertions; and it has proved impossible to make him pay due regard to his personal interests. So that toward the close of life he finds himself wrecked in body and impoverished in estate by thirty years of devotion to high ends. Among professed worshipers of humanity, who teach that human welfare should be the dominant aim, I have not yet heard of one whose sacrifices on behalf of humanity will bear comparison with those of my friend."

Though the volume containing this passage will not be published until after my death, I am very willing that this tribute of admiration to my late friend should be made public now.

I am, faithfully yours, HERBERT SPENCER.

A COMMITTEE of the British Association is charged with the collection of information respecting the disappearance or threatened disappearance of rare plants. While instances of complete extinction of any species within recent times may be rare, there are more of local extinction or of apparent extinction for a time, and the cases of threatened extinction are numerous enough to be alarming. A potent factor in the changes that have taken place is "the injudicious action of botanists themselves, and of botanical exchange clubs. The 'dealer' and 'collector' also figure largely in the process, while tourists are not responsible for much damage except indirectly by patronizing dealers. It is too often forgotten that the very rarity of a plant is the sign, and in great degree also the measure, of the acuteness of its struggle for existence, and that, when a plant is in unstable equilibrium with its environment, a small disturbance may have disproportionately great effects."

ON JUSTICE.

By HERBERT SPENCER.

[IN the January number of this Review* (page 126), I made the incidental statement that "should I be able to complete Part IV of the Principles of Ethics, treating of Justice, of which the first chapters only are at present written, I hope to deal adequately with these relations between the ethics of the progressive condition and the ethics of that condition which is the goal of progress—a goal ever to be recognized, though it can not be actually reached." These chapters were written nearly a year ago: the fourth, not quite finished, having been untouched since May last. In view of the possibility that the division of which they form part may never be completed, or otherwise that its completion may be long delayed, it has occurred to me that as the topic dealt with is now being discussed, these first chapters may, perhaps with advantage, be published forthwith. The editor having kindly assented to my proposal to issue them in this Review, I here append the first three: reserving two others, conveniently separable in subject-matter, for another article.]

I. ANIMAL-ETHICS.—Those who have not read the first division of this work† will be surprised by the above title. But the chapters on Conduct in General and The Evolution of Conduct will have shown to those who have read them that something which may be regarded as animal-ethics is implied.

It was there shown that the conduct which Ethics treats of is not separable from conduct at large; that the highest conduct is that which conduces to the greatest length, breadth, and completeness of life; and that by implication there is a conduct proper to each species of animal, which is the relatively good conduct—a conduct which stands toward that species as the conduct we morally approve stands toward the human species.

Most people regard the subject-matter of Ethics as being conduct considered as calling forth approbation or reprobation. But the primary subject-matter of Ethics is conduct considered objectively as producing good or bad results to self or others or both.

Even those who think of Ethics as concerned only with conduct which deserves praise or blame, tacitly recognize an animal-ethics; for certain acts of animals excite in them antipathy or sympathy. A bird which feeds its mate while she is sitting is regarded with a sentiment of approval. For a hen which refuses to

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* Nineteenth Century; also Popular Science Monthly for March, page 616.

† Reference is here made to the Data of Ethics.

sit upon her eggs there is a feeling of aversion; while one which fights in defense of her chickens is admired.

Egoistic acts, as well as altruistic acts, in animals are classed as good or bad. A squirrel which lays up a store of food for the winter is thought of as doing that which a squirrel ought to do; and, contrariwise, one which idly makes no provision and dies of starvation, is thought of as properly paying the penalty of improvidence. A dog which surrenders its bone to another without a struggle, and runs away, we call a coward—a word of reprobation.

Thus then it is clear that acts which are conducive to preservation of offspring or of the individual we consider as good relatively to the species, and conversely.

The two classes of cases of altruistic and egoistic acts of animals just given, exemplify the two cardinal and opposed principles of animal-ethics.

During immaturity benefits received must be inversely proportionate to capacities possessed. Within the family-group most must be given where least is deserved, if desert is measured by worth. Contrariwise, after maturity is reached, benefits must vary directly as worth: worth being measured by fitness to the conditions of existence. The ill fitted must suffer the evils of unfitness, and the well fitted profit by their fitness.

These are the two laws which a species must conform to if it is to be preserved. Limiting the proposition to the higher types (for in the lower types, parents give to offspring no other aid than that of laying up a small amount of nutriment with the germ; the result being that an enormous mortality has to be balanced by an enormous fertility)—thus limiting the proposition, I say, it is clear that if, among the young, benefit were proportioned to efficiency, the species would disappear forthwith; and if, among adults, benefit were proportioned to inefficiency, the species would disappear by decay in a few generations (see Principles of Sociology, section 322).

What is the ethical aspect of these principles? In the first place, animal life of all but the lowest kinds has been maintained by virtue of them. Excluding the *Protozoa*, among which their operation is scarcely discernible, we see that without *gratis* benefits to offspring, and earned benefits to adults, life could not have continued.

In the second place, by virtue of them life has gradually evolved into higher forms. By care of offspring which has become greater with advancing organization, and by survival of the fittest in the competition among adults which has become keener

with advancing organization, superiority has been perpetually fostered, and further advances caused.

On the other hand, it is true that to this self-sacrificing care for the young and this struggle for existence among adults, has been due the carnage and the death by starvation which have characterized the evolution of life from the beginning. It is also true that the processes consequent on conformity to these principles are responsible for the production of torturing parasites, which outnumber in their kinds all other creatures.

To those who take a pessimist view of animal-life in general, contemplation of these principles can of course yield only dissatisfaction. But to those who take an optimist view, or a meliorist view, of life in general, and who accept the postulate of hedonism, contemplation of these principles must yield greater or less satisfaction, and fulfillment of them must be ethically approved.

Otherwise considered, these principles are either, according to the current belief, expressions of the Divine will, or, according to the agnostic belief, indicate the mode in which works the Unknowable Power throughout the Universe; and in either case they have the warrant hence derived.

But here, leaving aside the ultimate controversy of pessimism *versus* optimism, it will suffice for present purposes to set out with a hypothetical postulate, and to limit it to a single species. If the preservation and prosperity of such species are to be desired, there inevitably emerge one most general conclusion and from it three less general conclusions.

The most general conclusion is that, in order of obligation, the preservation of the species takes precedence of the preservation of the individual. It is true that the species has no existence save as an aggregate of individuals; and it is true that, therefore, the welfare of the species is an end to be subserved only as subserving the welfares of individuals. But since disappearance of the species, implying disappearance of all individuals, involves absolute failure in achieving the end, whereas disappearance of individuals, though carried to a great extent, may leave outstanding such number as can, by continuance of the species, make subsequent fulfillment of the end possible; the preservation of the individual must, in a variable degree according to circumstances, be subordinated to the preservation of the species, where the two conflict. The resulting corollaries are these:

First, that among adults there must be conformity to the law that benefits received shall be directly proportionate to merits possessed: merits being measured by power of self-sustentation. For, otherwise, the species must suffer in two ways. It must suffer immediately by sacrifice of superior to inferior, which entails a

general diminution of welfare; and it must suffer remotely by furthering increase of the inferior and, by implication, hindering increase of the superior, and by a consequent general deterioration which, if continued, must end in extinction.

Second, that during early life, before self-sustentation has become possible, and also while it can be but partial, the aid given must be the greatest where the worth shown is the smallest—benefits received must be inversely proportionate to merits possessed: merits being measured by power of self-sustentation. Unless there are *gratis* benefits to offspring, unqualified at first and afterward qualified by decrease as maturity is approached, the species must disappear by extinction of its young. There is, of course, necessitated a proportionate self-subordination of adults.

Third, to this self-subordination entailed by parenthood has, in certain cases, to be added a further self-subordination. If the constitution of the species and its conditions of existence are such that sacrifices, partial or complete, of some of its individuals, so subserve the welfare of the species that its numbers are better maintained than they would otherwise be, then there results a justification for such sacrifices.

Such are the laws by conformity to which a species is maintained; and if we assume that the preservation of a particular species is a *desideratum*, there arises in it an obligation to conform to these laws, which we may call, according to the case in question, quasi-ethical or ethical.

II. Sub-Human Justice.—Of the two essential but opposed principles of action by pursuance of which each species is preserved, we are here concerned only with the second. Passing over the law of the family as composed of adults and young, we have now to consider exclusively the law of the species as composed of adults only.

This law we have seen to be that individuals of most worth, as measured by their fitness to the conditions of existence, shall have the greatest benefits, and that inferior individuals shall receive smaller benefits, or suffer greater evils, or both results—a law which, under its biological aspect, has for its implication the survival of the fittest. Interpreted in ethical terms it is that each individual ought to be subject to the effects of its own nature and resulting conduct. Throughout sub-human life this law holds without qualification; for there exists no agency by which, among adults, the relations between conduct and consequence can be interfered with.

Fully to appreciate the import of this law we may with advantage pause a moment to contemplate an analogous law; or, rather, the same law as exhibited in another sphere. Besides being displayed in the relations among members of the species, as respect-

ively well or ill sustained according to their well-adapted activities or ill-adapted activities, it is displayed in the relations of parts of each organism to one another.

Every muscle, every viscus, every gland, receives blood in proportion to function. If it does little it is ill-fed and dwindles; if it does much it is well-fed and grows. By this balancing of expenditure in action and payment in nutriment, there is, at the same time, a balancing of the relative powers of the parts of the organism; so that the organism as a whole is fitted to its existence by having the proportions of its parts continuously adjusted to the requirements. And clearly this principle of self-adjustment within each individual is parallel to that principle of self-adjustment by which the species as a whole keeps itself fitted to its environment. For by the better nutrition and greater power of propagation which come to members of the species that have faculties and consequent activities best adapted to the needs, joined with the lower sustentation of self and offspring which accompany less adapted faculties and activities, there is caused such special growth of the species as most conduces to its survival in face of surrounding conditions.

This, then, is the law of sub-human justice, that each individual shall receive the benefits and the evils of its own nature and its consequent conduct.

But sub-human justice is extremely imperfect, alike in general and in detail.

In general, it is imperfect in the sense that there exist multitudinous species the sustentation of which depends on the wholesale destruction of other species; and this wholesale destruction implies that the species serving as prey have the relations between conduct and consequence so habitually broken that in but very few individuals are they long maintained. It is true that in such cases the premature loss of life suffered from enemies by nearly all members of the species, must be considered as resulting from their natures—their inability to contend with the destructive agencies they are exposed to. But we may fitly recognize the truth that this violent ending of the immense majority of its lives, implies that the species is one in which justice, as above conceived, is displayed in but small measure.

Sub-human justice is extremely imperfect in detail, in the sense that the relation between conduct and consequence is in such an immense proportion of cases broken by accidents—accidents of kinds which fall indiscriminately upon inferior and superior individuals. There are the multitudinous deaths caused by inclemencies of weather, which, in the great majority of cases, the best members of the species are liable to like the worst. There are

other multitudinous deaths caused by scarcity of food, which, if not wholly, still in large measure, carries off good and bad alike. Among low types, too, enemies are causes of death which so operate that superior as well as inferior are sacrificed. And the like holds with invasions by parasites, often widely fatal. These attack, and frequently destroy, the most perfect individuals as readily as the least perfect.

The high rate of multiplication required to balance the immense mortality among low animals, at once shows us that among them long survival is not insured by superiority; and that thus the sub-human justice, which consists in continued receipt of the results of conduct, holds individually in but few cases.

And here we come upon a truth of great significance—the truth that sub-human justice becomes more decided as organization becomes higher.

Whether this or that fly is taken by a swallow, whether among a brood of caterpillars an ichneumon settles on this or that, whether out of a shoal of herrings this or that is swallowed by a cetacean, is an event quite independent of individual peculiarity: good and bad samples fare alike. With high types of creatures it is otherwise. Keen senses, sagacity, agility, give a particular carnivore special power to secure prey. In a herd of herbivorous creatures, the one with quickest hearing, clearest vision, most sensitive nostril, or greatest speed, is the one most likely to save itself.

Evidently, in proportion as the endowments, mental and bodily, of a species are high, and as, consequently, its ability to deal with the incidents of the environment is great, the continued life of each individual is less dependent on accidents against which it can not guard. And, evidently, in proportion as this result of general superiority becomes marked, the results of special superiorities are felt. Individual differences of faculty play larger parts in determining individual fates. Now deficiency of a power shortens life, and now a large endowment prolongs it. That is to say, individuals experience more fully the results of their own natures —the justice is more decided.

With creatures which lead solitary lives, the nature of sub-human justice is thus sufficiently expressed; but on passing to gregarious creatures, there enters into it a new element.

Simple association, as of sheep or deer, profits the individual and the species only by that more efficient safeguarding which results from the superiority of a multitude of eyes, ears, and noses over the eyes, ears, and nose of a single individual. Through the alarms more quickly given, all benefit by the senses of the most acute. Where this, which we may call passive co-operation, rises

into active co-operation, as among rooks where one of the flock keeps watch while the rest feed, or as among beavers where a number work together in making dams, or as among wolves where, by a plan of attack in which the individuals play different parts, prey is caught which would otherwise not be caught; there is still greater advantage to the individuals and to the species. And, speaking generally, we may say that gregariousness, and co-operation more or less active establish themselves in a species only because they are profitable to it; since, otherwise, survival of the fittest must prevent establishment of them.

But now mark that this profitable association is made possible only by observance of certain conditions. The acts directed to self-sustentation which each performs, are performed more or less in presence of others performing like acts; and there tends to result more or less interference. If the interference is great, it may render the association unprofitable. For the association to be profitable the acts must be restrained to such an extent as to leave a balance of advantage. Survival of the fittest will else exterminate that variety of the species in which association begins.

Here, then, we find a further factor in sub-human justice. Each individual, receiving the benefits and the injuries due to its own nature and consequent conduct, has to carry on that conduct subject to the restriction that it shall not in any large measure impede the conduct by which each other individual achieves benefits or brings on itself injuries. The average conduct must not involve aggressions of such amounts as to cause evils which outbalance the good obtained by co-operation. Thus, to the positive element in sub-human justice has to be added, among gregarious creatures, a negative element.

The necessity for observance of the condition that each member of the group while carrying on the pursuit of self-sustentation and sustentation of offspring, shall not seriously impede the like pursuits of others, makes itself so felt, where association is established, as to mold the species to it. The mischiefs from time to time experienced when the limits are transgressed, continually discipline all in such ways as to produce regard for the limits; so that such regard becomes, in course of time, a natural trait of the species. For, manifestly, regardlessness of the limits, if great and general, causes dissolution of the group. Those varieties only can survive as gregarious varieties in which there is an inherited tendency to maintain the limits.

Yet, further, there arises such general consciousness of the need for maintaining the limits, that punishments are inflicted on transgressors—not only by aggrieved members of the group, but by the group as a whole. A "rogue" elephant (always distin-

guished as unusually malicious) is one which has been expelled from the herd: doubtless because of conduct obnoxious to the rest —probably aggressive. It is said that from a colony of beavers an idler is banished, and thus prevented from profiting by labors in which he does not join: a statement made more credible by the fact that drones, when no longer needed, are killed by worker-bees. The testimonies of observers in different countries show that a flock of crows, after prolonged noise of consultation, will summarily execute an offending member. And an eye-witness affirms that among rooks, a pair which steals the sticks from neighboring nests has its own nest pulled to pieces by the rest.

Here, then, we see that the *a priori* condition to harmonious co-operation comes to be tacitly recognized as something like a law; and there is a penalty consequent upon breach of it.

That the individual shall experience all the consequences, good and evil, of its own nature and consequent conduct, which is that primary principle of sub-human justice whence results survival of the fittest, is, in creatures that lead solitary lives, a principle complicated only by the responsibilities of parenthood. Among them the purely egoistic actions of self-sustentation have, during the reproductive period, to be qualified by that self-subordination which the rearing of offspring necessitates, but by no other self-subordination. Among gregarious creatures of considerable intelligence, however, the welfare of the species occasionally demands a further self-subordination.

We read of bisons that, during the calving season, the bulls form an encircling guard around the herd of cows and calves, to protect them against wolves and other predatory animals: a proceeding which entails on each bull some danger, but which conduces to the preservation of the species. Out of a herd of elephants about to emerge from a forest to reach a drinking-place, one will first appear and look round in search of dangers, and, not discerning any, will then post some others of the herd to act as watchers; after which the main body comes forth and enters the water. Here a certain extra risk is run by the few that the many may be the safer. In a still greater degree we are shown this kind of action by a troop of monkeys, the members of which will combine to defend or rescue one of their number; for though in any particular case the species may not profit, since more mortality may result than would have resulted, yet it profits in the long run by the display of a character which makes attack on its groups dangerous.

Evidently, then, if by such conduct one variety of a gregarious species keeps up, or increases, its numbers, while other varieties, in which self-subordination thus directed does not exist, fail to do

this, a certain sanction is acquired for such conduct. The preservation of the species being the ultimate end, it results that where an occasional mortality of individuals in defense of the species furthers this preservation in a greater degree than would pursuit of exclusive benefit by each individual, that which we recognize as sub-human justice may rightly have this second limitation.

It remains only to point out the order of priority, and the respective ranges, of these principles. The law of relation between conduct and consequence, which, throughout the animal kingdom at large, brings prosperity to those individuals which are structurally best adapted to their conditions of existence, and which, under its ethical aspect, is expressed in the principle that each individual ought to receive the good and the evil which arises from its own nature, is the primary law holding of all creatures; and is applicable without qualification to creatures which lead solitary lives, save in that self-subordination needed among the higher of them for the rearing of offspring.

Among gregarious creatures, and in an increasing degree as they co-operate more, there comes into play a law, second in order of time and authority, that those actions through which, in fulfillment of its nature, the individual achieves benefits and avoids evils, shall be restrained by the need for non-interference with the like actions of associated individuals. A substantial respect for this law in the average of cases being the condition under which alone gregariousness can continue, it becomes an imperative law for creatures to which gregariousness is a benefit. But, obviously, this secondary law is simply a specification of that form which the primary law takes under the conditions of gregarious life; since, by asserting that in each individual the interactions of conduct and consequence must be restricted in the specified way, it tacitly reasserts that these interactions must be maintained in all other individuals.

Later in origin, and narrower in range, is the third law, that under conditions such that, by the occasional sacrifices of some members of a species, the species as a whole prospers, there arises a sanction for such sacrifices, and a consequent qualification of the law that each individual shall receive the benefits and evils of its own nature.

Finally, it should be observed that whereas the first law is absolute for animals in general, and whereas the second law is absolute for gregarious animals, the third law is relative to the existence of enemies of such kinds that, in contending with them, the species gains more than it loses by the sacrifice of a few members; and in the absence of such enemies this qualification imposed by the third law disappears.

III. HUMAN JUSTICE.—The contents of the last chapter foreshadow the contents of this. As, from the evolution point of view, human life must be regarded as a further development of sub-human life, it follows that from this same point of view, human justice must be a further development of sub-human justice. For convenience the two are here separately treated, but they are essentially of the same nature, and form parts of a continuous whole.

Of man, as of all inferior creatures, the law by conformity to which the species is preserved is that among adults the individuals best adapted to the conditions of their existence shall prosper most, and that individuals least adapted to the conditions of their existence shall prosper least—a law which, if uninterfered with, entails survival of the fittest, and spread of the most adapted varieties. And as before so here, we see that, ethically considered, this law implies that each individual ought to receive the benefits and the evils of his own nature and consequent conduct: neither being prevented from having whatever good his actions normally bring to him, nor allowed to shoulder off on to other persons whatever ill is brought to him by his actions.

To what extent such ill, naturally following from his actions, may be voluntarily borne by other persons, it does not concern us now to inquire. The qualifying effects of pity, mercy, and generosity, will be considered hereafter in the parts dealing with Negative Beneficence and Positive Beneficence. Here we are concerned only with pure justice.

The law thus originating, and thus ethically expressed, is obviously that which commends itself to the common apprehension as just. Sayings and criticisms daily heard imply a perception that conduct and consequence ought not to be dissociated. When, of some one who suffers a disaster, it is said—"He has no one to blame but himself," there is implied the belief that he has not any ground for complaint. The comment on one whose misjudgment or misbehavior has entailed evil upon him, that "he has made his own bed, and now he must lie in it," has behind it the conviction that this connection of cause and effect is proper. Similarly with the remark—"He got no more than he deserved." A kindred conviction is implied when, conversely, there results good instead of evil. "He has fairly earned his reward"; "He has not received due recompense"; are remarks indicating the consciousness that there should be a proportion between effort put forth and advantage achieved.

The truth that justice becomes more pronounced as organization becomes higher, which we contemplated in the last chapter, is further exemplified on passing from sub-human justice to

human justice. The degree of justice and the degree of organization simultaneously make advances. These are shown alike by the entire human race, and by its superior varieties as contrasted with its inferior.

We saw that a high species of animals is distinguished from a low species in the respect that since its aggregate suffers less mortality from destructive agencies, each of its members continues on the average for a longer time subject to the normal relation between conduct and consequence; and here we see that the human race as a whole, far lower in its rate of mortality than nearly all races of inferior kinds, usually subjects its members for much longer periods to the good and evil results of well-adapted and ill-adapted conduct. We also saw that as, among the higher animals, a greater average longevity makes it possible for individual differences to show their effects for longer periods, it results that the unlike fates of different individuals are to a greater extent determined by that normal relation between conduct and consequence which constitutes justice; and we here see that in mankind unlikenesses of faculty in still greater degrees, and for still longer periods, work out their effects in advantaging the superior and disadvantaging the inferior in the continuous play of conduct and consequence.

Similarly is it with the civilized varieties of mankind as compared with the savage varieties. A still further diminished rate of mortality implies that there is a relatively still larger proportion, the members of which, during long lives, gain good from well-adapted acts, and suffer evil from ill-adapted ones. While also it is manifest that both the greater differences of longevity among individuals, and the greater differences of social position, imply that in civilized societies more than in savage societies, differences of endowment and consequent differences of conduct are enabled to cause their appropriate differences of results, good or evil: the justice is greater.

More clearly in the human race than in lower races are we shown that gregariousness establishes itself because it profits the variety in which it arises, partly by furthering general safety and partly by facilitating sustentation. And we are shown that the degree of gregariousness is determined by the degree in which it thus subserves the interests of the variety. For where the variety is one of which the members live on wild food, they associate only in small groups: game and fruits widely distributed can support these only. But greater gregariousness arises where agriculture makes possible the support of a large number on a small area; and where the accompanying development of industries introduces many and various co-operations.

But that which was faintly indicated among lower beings is conspicuously displayed among human beings—that the advantages of co-operation can be had only by conformity to certain requirements which association imposes. The mutual hindrances liable to arise during the pursuit of their ends by individuals living in proximity, must be kept within such limits as to leave a surplus of advantage obtained by associated life. Some types of men, as the Abors, lead solitary lives, because their aggressiveness is such that they can not live together. And in view of this extreme case it is clear that though, in many primitive groups, individual antagonisms often cause quarrels, yet the groups are maintained because their members derive a balance of benefit—chiefly in greater safety. It is also clear that in proportion as communities become developed and their division of labor complex, the advantages of co-operation can be gained only by a still better maintenance of those limits to each man's activities necessitated by the simultaneous activities of others. This truth is illustrated by the unprosperous or decaying state of communities in which the aggressions of individuals on one another are so numerous and great as to prevent them from severally receiving the normal results of their actions.

The requirement that individual activities must be mutually restrained, which we saw is so felt among certain inferior gregarious creatures that they inflict punishments on those who do not duly restrain them, is a requirement which, more imperative among men, and more distinctly felt by them to be a requirement, causes a still more marked habit of inflicting punishments on offenders. Though in primitive groups it is commonly left to any one who is injured to revenge himself on the injurer, and though even in the societies of feudal Europe, the defending and enforcing of his claims was in many cases held to be each man's personal concern; yet there has ever tended to grow up such perception of the need for internal order, and such sentiment accompanying the perception, that infliction of punishments by the community as a whole, or by its established agents, has become habitual. And that a system of laws enacting restrictions on conduct, and punishments for breaking them, is a natural product of human life carried on under social conditions, is shown by the fact that among multitudinous nations composed of various types of mankind, similar actions, similarly regarded as trespasses, have been similarly forbidden.

Through all which sets of facts is manifested the truth, recognized practically if not theoretically, that each individual carrying on the actions which subserve his life, and not prevented from receiving their normal results good and bad, shall carry on these actions under such restraints as are imposed by the carrying on of

kindred actions by other individuals, who have similarly to receive such normal results good and bad. And vaguely, if not definitely, this is seen to constitute what is called justice.

We saw that among inferior gregarious creatures, justice in its universal simple form, besides being qualified by the self-subordination which parenthood implies, and in some measure by the self-restraint necessitated by association, is in a few cases further qualified in a small degree by the partial or complete sacrifice of individuals made in defense of the species. And now in the highest gregarious creature we see that this further qualification of primitive justice assumes large proportions.

No longer as among inferior beings demanded only by the need for defense against enemies of other kinds, this further self-subordination is, among human beings, also demanded by the need for defense against enemies of the same kind. Having become the predominant inhabitants of the Earth, and having spread wherever there is food, men have come to be everywhere in one another's way; and the mutual enmities hence resulting, have made the sacrifices entailed by wars between groups, far greater than the sacrifices made in defense of the groups against inferior animals. It is doubtless true with the human race, as with lower races, that destruction of the group or the variety does not imply destruction of the species; and it therefore follows that such obligation as exists for self-subordination in the interests of the group or the variety, is an obligation of lower degree than is that of sustentation of offspring, without fulfillment of which the species must disappear, and of lower degree than the obligation to restrain actions within the limits imposed by social conditions, without fulfillment of which the group will dissolve. Still, it must be regarded as an obligation to the extent to which the maintenance of the species is subserved by the maintenance of each of its groups.

But the self-subordination thus justified, and in a sense rendered obligatory, is limited to that which is required for defensive war. Only because the preservation of the group as a whole conduces to preservation of its members' lives and their ability to pursue the objects of life, is there a reason for the sacrifice of some of its members; and this reason no longer exists when war is offensive instead of defensive.

It may, indeed, be contended that since offensive wars initiate those struggles between groups which end in the destruction of the weaker, offensive wars, furthering the peopling of the Earth by the stronger, subserve the interests of the race. But even supposing that the conquered groups always consisted of men having smaller mental or bodily fitness for war (which they do not; for

it is in part a question of numbers, and the smaller groups may consist of the more capable warriors), there would still be an adequate answer. It is only during the earlier stages of human progress that the development of strength, courage, and cunning, are of chief importance. After societies of considerable size have been formed and the subordination needed for organizing them produced, other and higher faculties become those of chief importance; and the struggle for existence carried on by force, does not always further the survival of the fittest. The fact that but for a mere accident Persia would have conquered Greece, and the fact that the Tartar hordes very nearly overwhelmed European civilization, show that offensive war can be trusted to subserve the interests of the race only when the capacity for a high social life does not exist, and that in proportion as this capacity develops, offensive war tends more and more to hinder, rather than to further, human welfare. In brief we may say that the arrival at a stage in which ethical considerations come to be entertained, is the arrival at a stage in which offensive war, by no means certain to further predominance of races fitted for a high social life, and certain to cause injurious moral reactions on the conquering as well as on the conquered, ceases to be justifiable; and only defensive war retains a quasi-ethical justification.

And here it is to be remarked that the self-subordination which defensive war involves, and the need for such qualification of the abstract principle of justice as it implies, belong to that transitional state necessitated by the physical-force-conflict of races; and that they must disappear when there is reached a peaceful state. That is to say, all questions concerning the extent of such qualifications pertain to what we distinguished as relative ethics; and are not recognized by that absolute ethics which is concerned with the principles of right conduct in a society formed of human beings fully adapted to social life.

This distinction I emphasize here because throughout succeeding chapters we shall find that recognition of it helps us to disentangle the involved problems of political ethics.—*Nineteenth Century.*

THE constantly receding character of the unexplained was illustrated by Dr. Burdon Sanderson, in his address at the British Association, by reference to the discovery of the cell, which seemed to be a very close approach to the mechanism of life; "but now we are striving to get even closer, with the same result. Our measurements are more exact, our methods finer; but these very methods bring us to close quarters with phenomena which, although within reach of exact investigation, are, as regards their essence, involved in a mystery which is the more profound the more it is brought into contact with the exact knowledge we possess of surrounding conditions."

SUMPTUARY LAWS AND THEIR SOCIAL INFLUENCE.*

By WILLIAM A. HAMMOND, M. D.

THERE are many persons who have what they conceive to be the good of their fellow-creatures so greatly at heart that, when they can not succeed in making them conform to a standard of right and wrong that they have set up for themselves, endeavor to accomplish their object by legal enactments. It is true they are very apt to do this under the fiction of insuring the public welfare; but it is none the less a fact, even if we admit the force of their alleged motive, that such laws as those to which I refer interfere with the personal liberty of those against whom they are aimed, and this to an extent incompatible with that degree of freedom of will and of action which is inseparable from the individual in all communities founded upon what we call liberty. Moreover, they are inquisitorial in their nature, and, what is perhaps a point of even still greater importance, they fail to accomplish the object in view; and being continually evaded on one pretext or another, tend to diminish that respect for the majesty of law which all well-ordered citizens should entertain.

The history of sumptuary laws, or laws tending to limit luxury and expense, shows how truly the remarks just made are founded on fact; and yet in all ages of the world such laws have been passed, to be disobeyed, held in contempt, remaining on the statute-book unenforced, and finally either passing into oblivion or being formally repealed. As we are apparently passing through a stage of our national existence in which sumptuary laws are making their appearance, it seemed to me that the Society for Medical Jurisprudence and State Medicine might very properly have its attention directed to the subject.

Among the first within our knowledge to provide by law for the regulation of the appetite, the taste, the affections, the dress, and the most minute details in the life of a citizen was Sparta. Sparta was a small country and its people were few; they were surrounded by powerful neighbors. The first principle instilled into the mind of every individual was, that the state had a claim upon him superior to that of parents or of any relational or social bond. He was from the very cradle trained for war; luxury, being regarded as incompatible with true manliness, was to be suppressed at all hazards. Foreigners, being liable to become a disturbing factor in the system of discipline enforced, were not allowed to enter Sparta; even the feeble children, as being unfit

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for war and liable to become burdens on the community, were put to death. Gold and silver were excluded, and the coinage was of iron. As far as possible the whole nation was fed alike. That the system was effectual in accomplishing the object that Lycurgus had in view, is probably true. It succeeded just as persecution succeeds when it is thorough and implacable. A half-hearted system of persecution not only fails in its object, but invariably advances the cause against which it is directed. If, for instance, we could kill all those who oppose us in our efforts to make matters accord with our own way of thinking, we should undoubtedly be triumphantly successful; but if we only killed a few of them, it would not be long before the number of the remainder would be so augmented that they would kill us.

Nowhere has the inefficacy of sumptuary laws been more thoroughly demonstrated than in Rome. There the dress, the food, the furniture of the houses, were attempted to be regulated by law after law, which were either openly or secretly disobeyed, and which eventually disappeared from the statute-books. The cost of entertainments was limited; the number of guests a person might have at his house was restricted. No woman was allowed to have more than half an ounce of gold, or to wear a dress of more than one color, or to ride in a carriage. In France, during the Celtic period, a law was passed that women should drink water only. In 1188 or thereabout no person was allowed to wear garments of vair, gray, zibeline, or scarlet color. No laced or slashed garments were allowed, and no one could have more than two courses at meals. In 1328 scarlet was only permitted to be worn by princes, knights, and women of high rank. The use of silver plate was prohibited except to certain high dignitaries; and women were frequently sent to prison in forties, fifties, and sixties at a time for wearing clothes above their rank. Even as late as the seventeenth century gold, as an ornament on carriages, buildings, and gloves, was prohibited.

In England, during the reign of Edward IV, cloth of gold or silk of a purple color was prohibited to all but members of the royal family. Lords were allowed to wear velvet, knights satin, and esquires and gentlemen camelet. None but noblemen were allowed to wear woolen clothes made out of England, or fur of sables, and no laborer, servant, or artificer might wear any cloth which cost more than two shillings a yard. In the year 1336 an act of Parliament was passed which I quote in full, as showing to what extremes law can go in the way of interfering with the interior life of the citizens:

"Whereas heretofore, through the excessive and over-many sorts of costly meats which the people of this Realm have used more than elsewhere, many mischiefs have happened to the

people of this Realm: for the great men by these excesses have been sore grieved, and the lesser people who only endeavor to imitate the great ones in such sorts of meats are much impoverished, whereby they are not able to aid themselves nor their liege lord in time of need as they ought, and many other evils have happened as well to their souls as to their bodies, our Lord the King, desiring the common profit as well of the great men as of the common people of his Realm, and considering the evils, grievances, and mischiefs aforesaid, by the common assent of the prelates, earls, barons, and other nobles of his said Realm and of the commons of the said Realm, hath ordained and established that no man, of what state or condition soever he be, shall cause himself to be served in his house or elsewhere, at dinner-meal or supper, or at any other time, with more than two courses and each mess of two sorts of victuals at the utmost, be it of flesh or fish, with the common sort of pottages without sauce or any other sort of victuals. And if any man choose to have sauce for his mess he may, provided it be not made at great cost; and if flesh or fish be to be mixed therein it shall be of two sorts only at the utmost, either flesh or fish, and shall stand instead of a mess except only on the principal feasts of the year, on which days every man may be served with three courses at the utmost, after the manner aforesaid."

But laws and proclamations were of no avail, though they continued to be issued and passed down to the reign of Queen Elizabeth; and in the reign of James I all sumptuary laws were repealed. Since then the people of England have been allowed to wear, to eat, and to drink what they pleased.

In our own country the experiment has been tried with as much thoroughness and with practically as little result as has attended the attempt by other nations. As early as the year 1639 we have the prototype of that curious law enacted a few years ago in the State of Iowa, which prohibits one person from inviting another to take a drink, or treating, as it is called.

In the records of the colony of Massachusetts for the year mentioned we find as follows:

"Forasmuch as it is evident unto this Court that the common custom of drinking one to another is a mere useless ceremony, and draweth on that abominable practice of drinking healths, and is also an occasion of much waste to the good creatures and of many other sins," such things are declared to be a reproach to a Christian commonwealth and are not to be tolerated. However, invectives of the council appear to have been of little effect, notwithstanding the severity of the punishments which were meted out to those who infringed the laws. Drunkenness, which is at most only a vice, was made a crime; and in 1636 one Peter

Bussaker was condemned for drunkenness to be whipped with twenty stripes well laid on. Robert Coles, for drunkenness committed at Roxbury, was condemned to be disfranchised, and to wear about his neck so that it would hang upon his outward garment a letter D, made of red cloth, and set upon white, to continue this for a year, and not to leave it off at any time in public, under penalty of forty shillings for the first offense and five pounds for the second. Severity of punishments appeared only to aggravate the evil against which they were directed, for in 1648 the Court was forced to declare that "it is found by experience that a great quantity of wine is spent and much thereof is abused to excess of drinking and unto drunkenness itself, notwithstanding all the wholesome laws provided and published for the preventing thereof." It therefore orders, with a blind perversity which is a remarkable instance of the fatuity which actuates people when they endeavor to accomplish the impossible, that those who are authorized to sell wine and beer shall not harbor a drunkard in their houses, but shall forthwith give him up to be dealt with by the proper officer, under penalty of five pounds for disobedience.

Tobacco, for some cause or other, was especially obnoxious to the early colonial authorities of Massachusetts. The trade in the weed was only allowed to the *old* planters, but the sale or use of it was absolutely forbidden unless upon urgent occasion for the benefit of health and taken *privately*. It was also ordered that victualers or keepers of an ordinary shall not suffer any tobacco to be taken into their houses, under penalty of five shillings for every offense, to be paid by the victualer, and twelvepence by the person who takes it. Further, it was ordered that no person should take tobacco publicly, under the penalty of two shillings sixpence, nor privately in his own house or in the house of another before strangers; and that two or more shall not take it together anywhere, under the aforesaid penalty for every offense.

It is true these laws against the use of tobacco are not so severe as some that have been enacted in other countries, but they were equally inefficacious. Thus, a Sultan of Turkey issued an edict to the effect that any one of his subjects detected in the act of smoking should for the first offense have his cheeks bored and transfixed by his pipe; for the second offense he was to have his nose cut off; and for the third he was to lose his head. Fines in the case of the New-Englanders, and mutilation and death in the case of the Turks, have not in the slightest degree prevented the use of tobacco; and that some recent laws to which I shall presently draw attention will prove equally futile there can be no doubt.

In all these instances of sumptuary laws the ground has been

taken that not only was the individual to be benefited, but that society as a whole was to be improved. Prohibitory laws relative to the manufacture and sale of alcoholic liquors which have been enacted in this country in our own times are based upon this assumption, but the arguments that have been used by those advocating such laws show that this is not the only motive by which they are governed. It has been and still is repeatedly asserted in the speeches and writings of these people that those who indulge in alcoholic liquors or in the use of tobacco spend money which could otherwise be more profitably used, and that indulgence in the habit of drinking or smoking directly conduces to idleness and luxurious habits. These assertions are probably true, and the laws against which the practices in question are directed are essentially sumptuary laws.

The laws which several States have enacted relative to the manufacture and sale of alcoholic liquors are true sumptuary laws, notwithstanding the fact that it is claimed by their adherents that they are measures which every independent State having a regard for the welfare of society is in duty bound to enforce. On that ground there are many other acknowledged evils against which the law-making power might very properly direct its energies, and which would interfere scarcely less with personal rights. One chief difficulty with such laws is that if thoroughly enforced, they do harm to those who never under any circumstances drink intoxicating liquors to excess, and yet who are benefited by their moderate use. As a matter of fact they never are enforced equally upon all classes of the community. In the most severe of all the States it is perfectly practicable for any person with pecuniary means to import as much alcoholic liquor for his own use and that of his family and friends as he chooses. The poor man, to whom a glass of beer or of wine taken decently and in order might not only do no harm, but might supply a positive want of his system, has to go without, or else resort to all kinds of deceit and subterfuge to get what he wants. States exceed their legitimate powers when they undertake to prevent a person doing that which is beneficial to him, and which does no harm to any one else. Moreover, as I have already said, such laws, being in this age of the world impossible of enforcement, tend to bring all law into contempt. It is not necessary for me to go into detail on this point; every one who hears me knows how the prohibitory liquor laws of the various States that have passed them are disregarded and ridiculed. Every now and then we hear of some instance where an offender is arrested and punished, but for every one brought before the courts a thousand go unnoticed. In the States of Maine, Vermont, and Rhode Island I know from my own personal experience that, notwithstanding the stringent liquor

laws that exist, it is just as easy for a person to get any kind of liquor he wants as it is in the city of New York.

Upon one occasion, at a prominent hotel in the State of Rhode Island, while at the dinner-table, I asked the waiter to bring me a bottle of champagne. He departed, but returned in a few minutes with the information that I could not have it without a medical prescription. I took his wine-card and writing the mystic symbol "℞," followed it with the words "vini campaniæ, ℥ xxxij—Sig.: To be taken p. r. n."—signing my name to it. In a few minutes he returned with the bottle, and I could have had as many more as I wanted on the same terms.

Several of the States, as we know, have recently receded from their advanced position on prohibition, and the State of Rhode Island has by its Legislature recently resubmitted the question to the people.

In the State of Iowa, not only is there a stringent prohibitory law, but it is made a penal offense for one person to ask another to take a drink. Of course, as I learn from reliable information, the law is almost a dead letter. It can be evaded in a hundred different ways. For instance, one man invites another into his house, takes him to the sideboard, and, perhaps in the presence of a dozen witnesses, pours out two glasses of whisky, drinks one himself, looks away for a moment, and his friend drinks the other. He has not disregarded the letter of the law. Are not such laws as this the height of human folly?

The State of Minnesota has quite recently struck out still further in the same direction, and has to a still greater extent interfered with the personal liberty of the individual. A law framed, as we are told, by Senator Schaeffer, has recently gone into effect in that State, and which is designed to punish drunkenness. It provides for a fine of from ten to forty dollars for the first offense, from forty to sixty dollars for the second offense, and ninety days in the workhouse for the third. When asked what effect the law would have on the Minneapolis municipal court, Judge Maloney said:

"It will not materially change the order of things with us. Our custom in treating drunkenness is much the same as provided in the new law. There is, however, one feature of the law that differs from the ordinance under which we formerly worked. According to the ordinance, the offense was not punishable unless committed in some public place, while the statute covers drunkenness in secret as well as in the public street. I am glad this bill passed the Legislature. It makes it a crime now in our State to drink to excess, and it is an expression of the public condemnation of drunkenness. I think it will result in doing a great deal of good. For the reasons I have cited, the new law has created

no unusual features in the pastime of drunkenness in this city as yet. Its eventual effect will, of course, depend greatly upon the leniency or strictness of the authorities."

Now, that drunkenness is both a vice and a sin is not to be questioned; but, if the law-making power sets out to punish vices and sins, it will have its hands full, and will attempt an impossible task. The world has tried this experiment in almost all ages, and uniformly without success. Not very many years ago the ordinances of the Church were in some countries enforced by law; and even now some nations, and, I am sorry to say, some of the States of this very Union of ours, inflict severe punishments upon profane swearers and blasphemers, thus again punishing sins and vices as though they were crimes. A sin or a vice does not necessarily inflict injury upon others, whereas a crime does. Drunkenness is not of itself, properly speaking, a crime; but if a person through his drunkenness creates disorder in the streets, or is offensive in any respect to those with whom he comes in contact, he ought to be punished to just that extent that his disorderly or offensive conduct requires. It is almost impossible for a person to be drunk in the public streets without being in some degree disorderly and offensive, and he is very properly arrested and fined or imprisoned.

But if any law can be more ridiculous, more outrageous in its influence upon the liberty of the citizen, it is this one which the State of Minnesota has recently enacted. A man, for instance, in the sanctity of his own house gets quietly drunk and goes to bed. He has injured no living being but himself, and he has a right to injure himself if he is such a fool. He has a legal right to cut off his hand, or to knock out his teeth, or to punch out his eye, even though by these acts he does inflict injury indirectly upon those who are dependent upon him. He has a natural right to take his own life, and though the State of New York (the only community, to my knowledge, that has such a law upon its statute-book) makes the attempt at self-destruction a crime, the law is so absurd that no one yet has been punished under it.

Moreover, the Minnesota law against drunkenness is almost impossible of enforcement, unless under such a system of espionage and domiciliary visiting as would render it intolerable to any people having a spark of manliness or independence in their character. Think of a police officer armed with a warrant entering a man's house, finding him in bed and in an apparent state of insensibility. He applies the only test known to the average policeman, and smells the breath of his potential victim. He detects the odor of alcohol, and straightway drags the supposed offender before a magistrate. The man may have had a headache, and have taken a glass of wine or of some other liquor; he is naturally

indignant at being treated in so outrageous a manner, and utters his protest in no measured language; his conduct only serves to convince his captors that the charge based upon the odor of alcohol is well founded, and he is mulcted in forty or sixty dollars, or sent to the workhouse for ninety days, as the case may be. No one is safe under such a law; it is often a very difficult matter to determine whether a person is drunk or sober, and frequently it is impossible even by the most minute examination. Again, some people become intoxicated from a single glass of champagne, while others will drink two or more bottles with impunity. It is manifestly unjust to allow an individual peculiarity like this to establish the guilt or innocence of an accused person.

As I have said, why stop at making drunkenness a crime when there are other vices far more immoral and more destructive to the character of the perpetrator? Why not enact a law against lying? There are laws against slander, which injures the one against whom it is directed, and they are well enough, for to injure another is a crime. But lying in the abstract remains unnoticed by the penal statutes, though a more degrading vice in the eyes of all civilized mankind than mere drunkenness.

On the first of June of the year 1889 a statute went into effect in the State of New York which prohibits, under severe penalties, the selling of cigarettes to minors under the age of sixteen; and the State of Michigan has recently not only enacted a similar law, but goes farther, and interdicts the manufacture of cigarettes within the limits of the State. Is it to be supposed for one moment that minors under the age of sixteen in either State smoke fewer cigarettes than they did before these laws were passed? How is the vender to know in many cases whether the applicant for cigarettes is over sixteen or not? And is there any difficulty for any minor to get a companion who is undoubtedly over sixteen, or some one else, to buy cigarettes for him? Legislatures that pass such laws, and governors that sign them, are apparently ignorant of the first principles of jurisprudence. I venture to say that even now, although not two weeks have elapsed since the act went into effect, it is practically a dead letter in the city of New York and throughout the State generally, and I am quite sure that not a single conviction will ever be obtained under its provisions. I am not certain that our society did its full duty in not protesting against the statute-books being encumbered with such rubbish. Cigarette-smoking by minors is an evil to be suppressed by proper instruction and by the intervention of parents and guardians. If these latter can not prevent it, it is quite certain that all the policemen in the State, backed by all the majesty of this particular law, will have their labor for their pains.

THE STRENGTH OF SPIDERS AND SPIDER-WEBS.*

By HENRY C. McCOOK, D. D.

THE frailty of a spider's web has passed into a proverb. Yet, comparatively, the silken line of an orb-weaver is very strong. According to Schaffenberger, it requires ninety spinning threads of an *Epeïra* to yield one thread of the thickness of a caterpillar's thread; and, according to Leeuwenhoek, it requires eighteen thousand spider lines to make the thickness of a hair of the beard. These comparisons are suggestive, although in a measure deceptive, since there are vast differences in the size of the threads woven by Epeïroids. It is probable that the extraordinary strength of the thread is due to the superposition of a large number of extremely minute threads. However, after the thread is woven, Meckel could not recognize it as consisting of more than eight to ten strands. A geometric snare, whether vertical or horizontal, must be strong enough to sustain the weight of a spider of considerable size, such as *Argiope cophinaria* or *Epeïra insularis*, particularly when the female is heavy with eggs.

Blackwell thus determined by experiment the strength of a line by which a female *Epeïra diadémata*, weighing ten grains, had sustained itself from a twig: He attached to the extremity of the line a small piece of muslin with the corners nearly drawn together, so as to form a minute sack, into which he carefully introduced sixty-one grains' weight in succession, being more than six times the weight of the spider. On the addition of half a grain more the line broke.

Not only must an orb sustain the weight and movements of its maker, but it must also have sufficient strength to hold the various insects which strike upon it. Bees and wasps are sometimes able to break through the spiral meshes of a large snare, but generally the threads are strong enough to hold them, in spite of their struggles, until the proprietor can enswathe them. Moreover, the orb-web must be able to sustain the weight of evening dews. One who has seen such snares in the early morning, when every viscid bead appears to have attracted to itself an incasing armor of silvery dew, and has noticed how the spiral strings are bagged down under the weight of the same (Fig. 1), must have inferred that the snare was able to support a comparatively heavy burden. The same is true concerning summer showers, which must fall very heavily, and be driven before a pretty strong wind, in order to batter down a well-constructed orb-web.

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* Reprinted from Vol. I of American Spiders and their Spinning-Work, by the kind permission of the author, to whom we are also indebted for the accompanying illustrations.

An illustration of the remarkable strength and elasticity of the foundation lines of orb-webs appears in a biographical notice of the distinguished astronomer, the late General Ormsby M. Mitchell, printed with an edition of his lectures. Prof. Mitchell directed his great ingenuity to the problem of causing a clock to record its beats telegraphically, and at the same time perfectly perform the work of a time-keeper. The required makes and breaks in the battery were effected by means of a cross of delicate wire and a mercury-cup. Many obstacles having been overcome, there arose the great difficulty of procuring a fiber sufficiently minute and elastic to constitute the physical union between the top stem of the cross and the clock pendulum. Various materials were tried, among others a delicate human hair, the very finest that could be obtained, but this was too coarse and stiff. Its want of pliancy and elasticity gave to the minute "wire cross" an irregular motion, and caused it to rebound from the globule of mercury into which it should have plunged. "After many fruitless attempts," says Prof. Mitchell, "an appeal was made to an artisan of wonderful dexterity—the assistance of the spider was invoked; his web, perfectly elastic and perfectly pliable, was furnished, and this material connection between the wire cross and the clock pendulum proved to be exactly the thing required. In proof of this remark I need only state the fact that one single spider's web has fulfilled the delicate duty of moving the wire cross, lifting it, and again permitting it to dip into the mercury every second of time

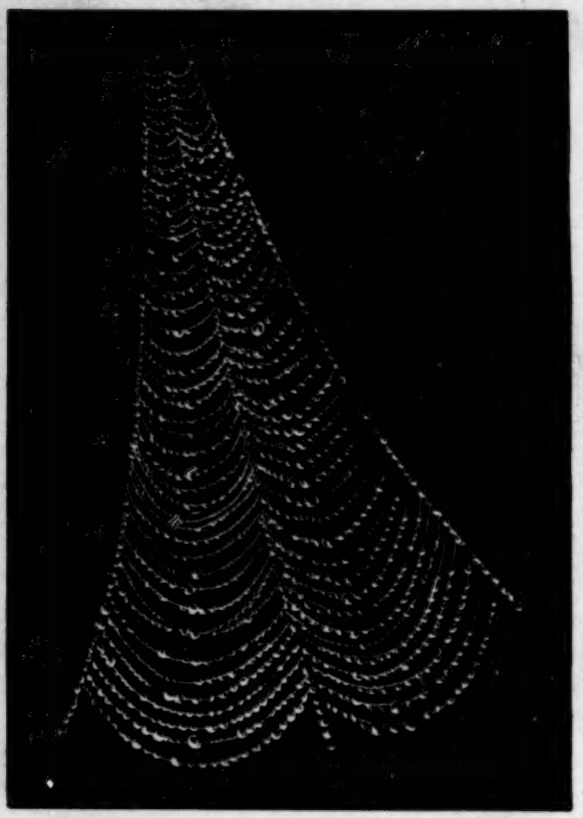

FIG. 1.—SECTOR OF A DEW-LADEN ORB-WEB. (Magnified.)

for a period of more than three years! How much longer it might have faithfully performed the same service I know not, as it then became necessary to break this admirable bond, to make some changes in the clock. Here it will be seen that the same web was expanded and contracted each second during the whole period, and yet never, so far as could be observed, lost any portion of its elasticity."

At various times there have been placed on record accounts of the capture by spiders of small vertebrate animals, as snakes, mice, and birds. Popular stories to the same effect have from time to time been sent the rounds of the daily press, and found utterance and often illustration, the latter sometimes of a most original and remarkable character, in popular magazine literature. The great seeming disparity, in such cases, between the size and vigor of captive and prisoner; the confusion of the various narratives in details as to the species and behavior of the spider, and the characteristics of her snare; the radical departure from known food habit of species that are insectivorous; together with the fact that the accounts all have come from lay observers, have been more or less lacking in scientific accuracy and minuteness of detail, and wholly without scientific verification—these considerations have caused such records and reports to be discredited by arachnologists and naturalists generally. But there are a few cases, confirmed by circumstantial evidence, and reported by observers of good reputation and careful habit, which deserve notice.

The physical powers of the *Lycosidæ*, the popular running, ground, or wolf spiders, are well illustrated by an instance recorded in the proceedings of the Academy of Natural Sciences of Philadelphia. The result as reported was achieved by pure strength and activity, without any of the mechanical advantages of a snare. Mr. Spring, while walking with a friend in a swampy wood, which was pierced by a dike three feet wide, was attracted by the extraordinary movements of a large black spider in the middle of a ditch. Closer examination showed that the creature had caught a fish! She had fastened upon it with a deadly grip just on the forward side of the dorsal fin, and the poor fish was swimming round and round slowly, or twisting its body as if in pain (Fig. 2). The head of its black enemy was sometimes almost pulled under water, but the strength of the fish would not permit an entire submersion. It moved its fins as if exhausted, and often rested. Finally it swam under a floating leaf near the shore and made a vain effort to dislodge the spider by scraping against the under side of the leaf.

The two had now closely approached the bank. Suddenly the long black legs of the spider emerged from the water, and the hinder ones reached out and fastened upon the irregularities of

the sides of the ditch. The spider commenced tugging at his prize in order to land it. The observer ran to the nearest house for a wide-mouthed bottle, leaving his friend to watch the struggle. During an interval of six or eight minutes' absence the spider had drawn the fish entirely out of the water; then both creatures had fallen in again, the bank being nearly perpendicular. There followed a great struggle, and on Mr. Spring's return the fish was already hoisted head first more than half its length out upon the land. It was very much exhausted, hardly making any movement, and was being slowly and steadily drawn up by the spider, who had evidently gained the victory. She had not once quit

FIG. 2.—A FISH CAPTURED BY A DOLOMEDE SPIDER.

her hold during the period of a quarter to half an hour of observation. Her head was directed toward the fish's tail; she stepped backward up an elevation of forty-five degrees, dragging her captive with her.

The observers were unfortunately unable to await the issue of the matter, and therefore caught the combatants in the bottle, partly filled with water. The fish swam languidly at the bottom of the vessel, and the spider stood sentinel on the surface, turning when the fish turned and watching every motion. The bottle was set aside and visited after an interval of three hours. The spider was then found dead at the bottom of the jar, but the fish was alive and lived twenty-four hours afterward. The spider was three fourths of an inch long and weighed fourteen grains; the fish was three and one fourth inches long and weighed sixty-six grains. The spider was probably bruised by the catching.

One of the most remarkable records of the physical and mechanical powers of spiders is made in Silliman's Journal. The account is authenticated by the names and statements of a number of gentlemen resident in the vicinity of the occurrence, Batavia, N. Y. One evening Hon. David E. Evans found in his wine-cellar a live striped snake, nine inches long, suspended by the tail in a spider's web between two shelves. The snake hung so that its head could not reach the shelf below it by about an inch. The shelves were about two feet apart, and the lower one was just below the bottom of a cellar window, through which the snake probably passed into it. From the upper shelf there hung a web in the shape of an inverted cone, eight or ten inches in diameter at the top, and concentrated to a focus about six or eight inches from the under side of this shelf. From this focus there was a strong cord made of the multiplied threads of the spider's web, apparently as large as sewing-silk, and by this cord the snake was suspended. A rude sketch of the serpent suspended in the web was made by an eye-witness, and is exactly reproduced at Fig. 3. A close examination showed that the snake's mouth was entirely closed by a number of threads wound around it. Its tail was tied in a knot so as to leave a small loop or ring, through which the cord was fastened, as seen in the figure.

FIG. 3.—A SNAKE ENTANGLED IN A SPIDER'S WEB.

Accepting the account as true, or at least probable, I would make the following inferences: First, the description of the web, although sufficiently indefinite, leaves little doubt that the snake was originally taken in a snare of a species of tube-weaver, and most probably by the medicinal spider, *Tegenaria medicinalis* (Hentz). The broad-sheeted web of this spider is frequently found in cellars, which are favorite haunts. It builds near windows, in the angles and along the sides of walls, having its tubular den in a crack or opening laid along an angle (Fig. 4). The sheet is usually drawn upward until its exterior margin is higher than the plane of the entrance of the tube. There is thus formed a sort of pouch within which insects often fall, and so are readily captured by the spider, who mounts guard at the door of her den. Over the door the tube frequently rises into a sort of tower.

I had often wished for an opportunity to follow up critically one of the recurring reports of the physical powers of spiders.

This wish was gratified in the summer of 1882. An article drifted through American newspapers which detailed the ensnaring of a living mouse by a Kentucky spider. I was fortunately able to trace the story to its origin in the Lebanon (Ky.) Standard and Times. Correspondence with its intelligent editor, Mr. J. W. Hop-

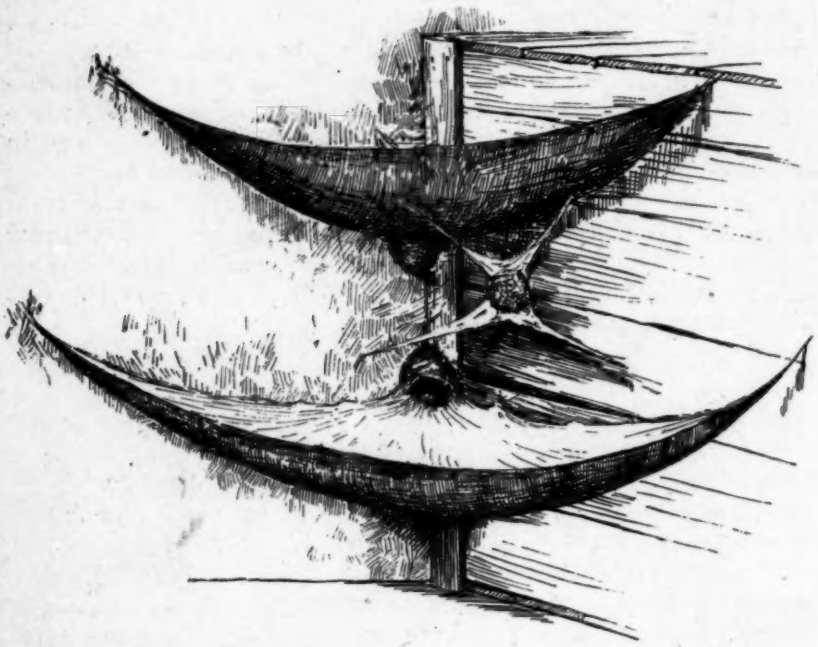

FIG. 4.—THE POUCH, WEB, TOWER, AND COCOON OF THE MEDICINAL SPIDER.

per, brought me entire confirmation of the report from a number of trustworthy sources. I think the incident of sufficient importance to justify a somewhat detailed presentation. The original account, as published by Mr. Hopper, is as follows:

"A very curious and interesting spectacle was to be seen Monday afternoon in the office of Mr. P. C. Cleaver's livery-stable in this city. Against the wall of the room stands a tolerably tall desk, and under this a small spider, not larger than a common pea, had constructed an extensive web reaching to the floor (Fig. 5). About half past eleven o'clock Monday forenoon, it was observed that the spider had ensnared a young mouse by passing filaments of her web around its tail. When first seen, the mouse had its fore-feet on the floor, and could barely touch the floor with its hind-feet. The spider was full of business, running up and down the line and occasionally biting the mouse's tail, making it struggle desperately. Its efforts to escape were all unavailing, as the slender filaments about its tail were too strong

for it to break. In a short time it was seen that the spider was slowly hoisting its victim into the air. By two o'clock in the afternoon the mouse could barely touch the floor with its fore-feet; by dark the point of its nose was an inch above the floor. At nine o'clock at night the mouse was still alive, but made no sign except when the spider descended and bit its tail. At this time it was an inch and a half from the floor. Yesterday morning the mouse was dead, and hung three inches from the floor. The news of the novel sight soon became circulated, and hundreds of people visited the stable to witness it. The mouse was a small one, measuring about an inch and a half from the point of its nose to the root of the tail."

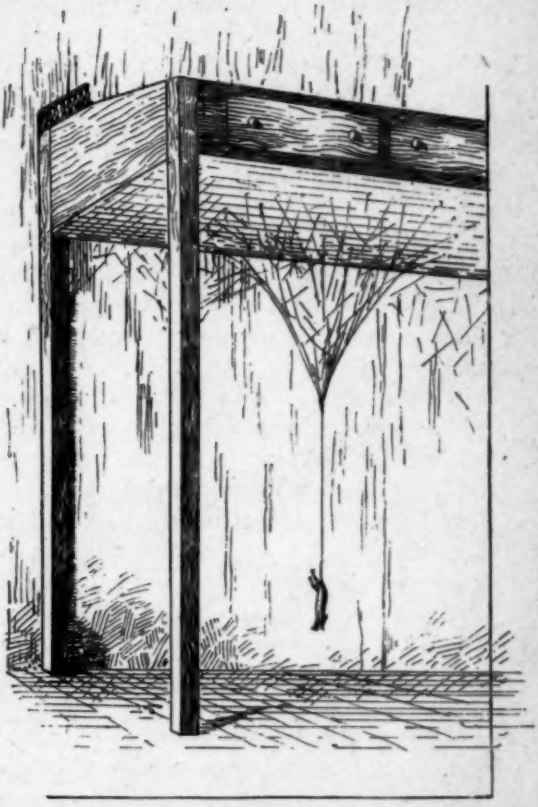

FIG. 5.—A MOUSE HANGING IN A SPIDER'S SNARE.

The space given the above facts may seem to some to be in undue proportion to their importance. But, apart from the value of positively determining any point in natural history, the discussion has this conclusion: The capture of small vertebrate animals by both sedentary and wandering spiders is possible; the one by the mechanical strength of their snares, the other by their physical strength. There is thus laid the foundation, at least, for the presumption that such animals may be or become natural food for the larger species of araneads. This is certainly a most important fact in the life-history of spiders, and would greatly enlarge the range of their habits.

MR. F. J. MOSS, of the New Zealand Legislature, and an extensive traveler in Polynesia, suggests that the deterioration of the natives of those regions may be partly due to faulty instruction. It is neither desirable nor expedient to thwart Nature too much. What is most needed, this author thinks, is to allow the islanders in their work and their amusements free scope for the imaginative powers with which they are endowed, and the exercise of which is too often foolishly discouraged.

SECONDARY SCHOOL PROGRAMMES—FRENCH AND AMERICAN.

By GEORGE W. BEAMAN.

THE general subject of American secondary school programmes has been of late years a most prolific one. What with the relative or particular importance of the mother-tongue, classical studies, history, modern languages, and, more recently, manual training, the educational essayist has been rather embarrassed by the multitude of the topics presented him. As the result of much discussion, contention, and wordy warfare, we have, however, to-day, certain secondary school programmes, generally speaking quite similar in their character, marking in a more or less defined manner the routes along which our boys are traveling on their respective journeys to college, to scientific school, or to practical business life. While there is to be noted a decided advance and improvement in pedagogical methods in our secondary schools within the last few decades, it yet remains true that no intelligent reader of the programmes, as exhibited in the catalogues of our leading endowed fitting schools, and public grammar and high schools, can fail to be struck by a certain lack of co-ordination, system, and, in most instances, by an apparent want of a genuine appreciation of the real demands that the present age makes upon modern secondary schools. Once outside the old fixed limits of the classics, there is to be observed much disagreement among the schools themselves, both as to the proper subjects to be included in the programme and the relative time to be devoted to the studies that are placed in the school curriculum. When comparison of these programmes with those of other countries is made, we have at once afforded us a most striking exemplification of how far we still are in this country from any well-defined consensus as to what the modern secondary school programme really should be. In view of the revolutionary period through which the schools have been passing during the past thirty years, this is perhaps hardly to be wondered at. The broadening of the college requirements for entrance, largely brought about by the demands of a public sentiment, no longer fully satisfied with purely mediæval curricula, has in itself served to call for many modifications of the secondary schools' programme. With Harvard and Johns Hopkins opening their doors to students unequipped with the traditional Greek, there has of course arisen a demand for preparation in other prerequisites which have necessarily been substituted for Greek. In response to the general outcry for them, the courses in modern languages, in the mother-tongue, history, and

particularly in science studies, have had to be greatly extended or recast. The many admirable scientific schools and colleges throughout the country have made demands for special preparation that have had to be met. Furthermore, it has come to pass that the college prerequisites in the old classical studies even have been very considerably increased. Altogether it may be stated that the demands made upon the preparatory schools to-day are probably at least twenty-five or thirty per cent in excess of the demands of twenty-five or thirty years ago. Coincident with this multiplication and extension of preparatory studies, there has arisen in our country a sentiment which to no inconsiderable extent has reduced the hours devoted to study. A few decades since a boy fitting for college with its limited requirements in Latin, Greek, and mathematics, spent six hours per diem in school, and, as a matter of course, expected to give two, three, or possibly more hours to study at home. Now, he spends four or five hours in the school-room; and the sight of a text-book under his arm as he idly saunters homeward excites comment in the community as to the severe mental strain to which school-children are nowadays subjected by rigorous masters.

The result of all this is a state of affairs to which President Eliot, of Harvard University, has recently invoked the serious attention of the American public.* He states that the average age of admission to Harvard University has been gradually rising for many years, and has now reached the extravagant age of eighteen years and ten months. He also notes that in view of the increased time required for the completion of his professional education, after leaving college, it follows that a man, thoroughly preparing himself for life, finds himself unprepared for self-support much before he is twenty-seven years old. This result is by no means peculiar to Harvard or to Harvard graduates, but holds true as to all colleges in the United States. Its remedy, in the opinion of President Eliot, is in both shortening and enriching our secondary school courses of study. As illustrating what other countries have succeeded in doing in this direction, he cites the school courses of France. The hours of recitation of these courses, less elaborate and difficult than those of Germany, are, he claims, so far as hours of recitation are concerned, substantially the same as those of this country; yet, under them, the French boy is better prepared for matriculation at seventeen years of age than ours are at nineteen. He therefore calls for a serious examination of the programmes of *l'enseignement secondaire classique* of France in comparison with the programmes of American preparatory

* A paper read before the Department of Superintendence of the National Educational Association at Washington, February 16, 1888, published in the Atlantic Monthly, August, 1888. Remarks before the Commercial Club, Providence, R. I., March, 1889.

schools, as likely to yield results which can not but be conducive to educational progress in this country.

As might be expected from the eminence of its author, the paper of President Eliot has excited much interest in regard to the French secondary school programmes. Much comment has resulted both as to the facts and the conclusions arrived at. The facts represented in the address as to the age of matriculates in American colleges are only too patent. The defects of the programmes of the preparatory schools of this country are unfortunately equally patent. The great need of some readjustment of existing methods of our fitting schools and schools of grammar and even primary grades, for the benefit of boys preparing for modern collegiate, scientific, and university training, is so imperative that no friend of educational advance in this country can fail to welcome this valuable contribution to the literature of the subject given by the President of Harvard University. But, notwithstanding his admirable paper, and the comment which has followed, so far as one can judge from the literature of the controversy, no one has apparently made haste to follow President Eliot's advice and make any serious comparative examination of the French and American school programmes. On the contrary, there are indications that, with true American inconsequence, many persons are already either clamoring for the adoption of the French curricula forthwith, as a panacea for all our secondary school deficiencies, or, with great lack of knowledge and accurate information, are condemning them outright as a foreign growth quite unsuited to American soil. This is to be regretted; for assuredly the comparative study of the programmes of the two countries would give American school boards and American parents much information that should be known and accurately known. This examination is additionally desirable from the fact that, in his felicitous presentation of some characteristics of the lycée curriculum, Dr. Eliot seems to have omitted to note some of the more important features of the programmes that give them their strength, and has quite failed to point out how it happens that the French boy is really enabled to pass his examinations for the *baccalauréat ès lettres* at the early age of seventeen years. It may also be said that the examination is likewise desirable for the reason that President Eliot has inadvertently made some statements as to the French courses of study that the official programmes hardly seem to warrant.

In the present paper the attempt will be made to present, in a somewhat more precise manner than has been undertaken by President Eliot, certain details of the curricula of not only the classical lycées, but also of the secondary special schools of France. In connection with this, the attempt will also be made to

exhibit, with equal precision, some facts as to comparative courses in vogue in typical preparatory schools of the United States. Following the suggestion of Dr. Eliot, particular reference will be made to the Public Grammar and Public Latin School of the city of Boston. To obtain the requisite data the writer has first tabulated the hours of recitation per week entering into the *enseignement secondaire classique* and the *enseignement secondaire spécial* of France. These tables have then been brought into comparison with similar tables, prepared on precisely the same plan, of the courses of study in both the classical and scientific departments of certain typical fitting schools in the United States. The hours of recitation having been made the unit of the tabulation, the tables thus exhibit the total number of recitations in every subject taught, each year, and for the entire course of every school subjected to this examination. From the resultant figures the percentage of each study to the whole course has been also derived. The data as to the French courses were collated from the latest official programmes of the schools, as prescribed by the order of January 22, 1885, for the classical lycées,* and by the order of August 10, 1886, for the secondary special schools.† The data as to American schools were derived from information supplied by the head masters of the schools in question. The result of this tabulation has been to exhibit in full relief the curricula of both countries, and to bring into graphic view some very striking points of difference in the courses of study as carried out in the French and American schools, as well as to expose many singular differences of practice obtaining in our own schools. The large space that these tables would occupy precludes their publication in connection with this paper, but the methods of compilation are here mentioned, in order that such statemen's as may be made by the writer as to the details of the courses of instruction in both countries may be depended on as being as absolutely correct as a careful and conscientious tabulation can make them.

The programmes thus compared, at once exhibit two most important facts to which President Eliot has made no reference whatsoever, viz.: that if a boy in France is prepared for matriculation at seventeen years of age, instead of nineteen, as with us, it is due (1) to the fact that, between the ages of eight and seventeen, the French boy devotes more time to study than the American boy; and (2) to the further fact that, with his increased amount of reading, the French lad has had eliminated from his preparatory course the serious study of subjects considered by the

* Plan d'Études des Lycées—Programmes de l'Enseignement classique. Paris: Maison Delalain Frères.

† Plan d'Études et Programmes de l'Enseignement secondaire spécial dans les Lycées et Colléges prescrit par Arêté du 10 Aout, 1886. Paris: Maison Delalain Frères.

French school authorities non-essential to that particular course, but which with us are still firmly intrenched in every preparatory school programme; in brief, that the results obtained under the French programmes, in both the classical and scientific preparatory schools, are due to honest hard work, persistently continued for a term of years on a well-defined plan, which is characterized by a complete disjunction of the courses that lead to college, from those that are intended for youth for whose anticipated career in life a knowledge of the classical languages is not deemed essential.

A comparative examination of the programmes of the Boston Latin School with the French lycée course brings out this excess of hours in the French school very prominently. The French boy, in his ten years' sojourn in the lycée, spends 8,560 hours in the recitation-room, while in the corresponding course in Boston* the recitation hours are 7,790 only. With a ten-per-cent excess in recitation hours, and a corresponding increase of study, it is evident that the two courses can not be considered "as substantially of the same strength." However much we might "enrich" our curricula by imitating French methods, it seems quite clear that we certainly could not, by this process, hope to "shorten" them any.

Turning to the relative assignment of time to the subjects taught in common by the two schools, there is to be noted also one other point where the statistics and Dr. Eliot are at variance. One searches in vain for that "preponderance" of time given to the French language in the lycées as compared with the instruction in the English language in the Boston Latin School. In fact, the "preponderance" is, on the contrary, altogether on the side of the Boston schools, where over twenty-eight per cent of the whole course is devoted to the mother-tongue, to only 20·8 per cent in the lycées. This is an interesting fact, which will doubtless be surprising to most readers. It is a prevalent opinion in the United States that in our schools too little time is devoted to the study of our own language. And lest it may be urged that this "preponderance" is offset by the nine hours' course per week in philosophy, given in the last year, where, President Eliot states, "French resumes almost exclusive possession of the programme," it may be said that, according to the official programme, this claim can not be legitimately made. The course of philosophy in question em-

* The programme of the Boston Latin School, embracing six years of study, and that of the French lycées ten years, there have been prefixed to the tables of the Latin School —for purposes of comparison—the recitation hours of four years of the grammar-school courses preliminary to it. All references to the Latin School courses in this paper will, therefore, be understood as embracing the result of tabulation of ten years' school work—not that of the six years' course of the Latin School proper.

braces the elements of psychology, logic, morals, and metaphysics, with a study of the principal schools of philosophy and the various philosophical authors. In connection with the last-mentioned branch of the course, as is natural, considerable prominence is given to the French philosophical writers, and one hour per week of the nine is expressly devoted to the Latin and Greek authors. This course of philosophy, admirable as it is, and interesting as (perhaps) it may be to the average youngster of seventeen years, can in no sense be properly classed as an adjunct to the mother-tongue instruction, except in so far as history, geography, or any other branch of study, carried on in the vernacular, can be so considered. In the programme it is very properly classified by itself.

Referring to the courses in modern languages, there is certainly here no question as to where the preponderance lies. In the French lycée the living languages are made prominent from the preparatory year, and the strength of the course developed in the first three years. The total is 1,000 hours, or 11·7 per cent of the whole hours, compared with 380 hours, or 4·9 per cent only in the Boston Latin School. Latin and Greek, which naturally form the *pièces de résistance* of the French classical course, are, as one might expect, much more prominent than with us. The Latin is begun in *cinquième*, the pupil eleven years of age, with ten hours of recitation per week, and is continued with reduced hours for six years, giving a total of 1,500 hours, against 1,293 hours at the Boston Latin School. In the last year (*classe de philosophie*) the technical study of Latin is omitted, but, as above stated, one hour per week of the nine allotted to philosophy is devoted to Greek and Latin authors, the original texts being freely employed. Greek is begun in the second term of the fourth year of the course, the pupil twelve years of age, with two hours per week for the rest of the year, and is continued through the *classe de rhétorique*. Taken together, the Greek and Latin recitations of the French course occupy 2,340 hours, contrasted with 1,805 hours in the Boston Latin School.

The importance attached to drawing in the French scheme of instruction is shown by the considerable time devoted to it. This is in most striking contrast to the almost general neglect of this important branch of education, not only at the Latin School of Boston, but at nearly all classical fitting schools in the United States. In the French lycée 7·9 per cent of the whole course is devoted to drawing; in the Boston Latin School the percentage is 2·9.*

Among the various illustrations of the difference of the two

* In the Latin School proper no instruction in drawing is given. The percentage referred to is derived from the preceding grammar-school courses.

programmes, none is more interesting than that of the relative number of hours devoted to mathematics in the French and American courses. The figures are as follows: French lycée, 740 hours; Boston Latin School, 1,387 hours. The French boy arrives at the end of his classical preparatory course of study, having been subjected on an average to less than two hours of recitation per week in mathematical subjects. The average American pedagogue would certainly rise with protests deep, and disgust profound, if ever it were proposed to him to fit a boy for college with an allowance of only 8·7 per cent of the whole school course for his arithmetic, algebra, and geometry.* Yet this is precisely what the French do—in their classical course. In the Boston representative course the percentage is 17·8 per cent.

As the treatment of mathematics in the French classical course, with the limited time allotted to this study, is of general interest, a *résumé* of it is given here. In the preparatory class of the lycée, as well as in the *classe de huitième* following, the allotted time is devoted to simple arithmetical work in whole numbers, mental work, and to the solving of easy problems. In *septième* (third year of the course) are added decimal numbers and the metric system, with drawing of geometrical figures. In the next year there is a review of work on whole numbers, a continuation of mental exercises and problems, and decimals; work on fractions is entered upon, and elementary geometry is begun. In the succeeding year arithmetic is continued, with the study of the rule of three, interest, discount, with simple problems in alligation, a detailed review of the metric system, and with further very elementary geometrical exercises. In *quatrième*, theoretical geometry is begun, with one recitation per week. In *troisième*, the two hours per week are devoted to a review of arithmetical subjects,

* The percentage of hours devoted to recitations in mathematics, in such typical fitting schools of the United States as have supplied data to the writer, is as follows: Boston Latin School (with four years' grammar-school course added), 17·8 per cent. Boston English High School (with two years' grammar-school course added), 16·6 per cent. Phillips Academy, Exeter, N. H., classical course, 26·5 per cent; scientific course, 26·9 per cent. Williston Seminary, Easthampton, Mass., classical course, 26·7 per cent; scientific course, 25·7 per cent. Phillips Academy, Andover, Mass., classical course, 25·7 per cent; scientific course, 28·8 per cent. St. Paul's School, Concord, N. H., classical course, 24·9 per cent; scientific course, 27·8 per cent. Lawrenceville School, Lawrenceville, N. J., classical course, 17 per cent; scientific course, 22·7 per cent. St. Mark's School, Southborough, Mass., exclusively classical, 21·6 per cent. Doubtless these percentages may, in some of the schools cited, be increased or decreased in the case of certain pupils; but they represent the mathematical courses as prescribed for the major portion of them. How strikingly the figures illustrate the different methods of treatment of the mathematical question, in the United States and France, will be understood when it is further stated that the percentage allowed to mathematics in the French lycée course is only 8·7 per cent, and in the secondary special course, where mathematical studies are considered by the French to be especially prominent, only 17 per cent.

elementary algebra is begun, and geometry is continued. In *classe de rhétorique* (ninth year of the course), two hours a week are devoted to recitations in solid geometry and cosmography; and in the last year (*classe de philosophie*), four hours per week, are devoted to a complete review of the work of the previous years in arithmetic, algebra, and geometry.

It must be admitted that in this country the mathematical instruction, sketched above, would be thought to afford a somewhat meager outfit for a young man intending to present himself for examination at any of our American colleges, with their present mathematical prerequisites. It is also obvious that the French, who, according to President Eliot, "are quite as skillful with numbers as the Americans," do not gain a skill in "ciphering" in the classical lycée course. This proficiency is obtained elsewhere, as will be further shown. The French are, indeed, not only skillful with numbers, but are as a nation eminent for their mathematical ability; and their management of the much-vexed problem of the relative time to be devoted to elementary mathematical branches in the classical fitting schools commends itself to the serious consideration of American educators. A comparative exhibit of the classical lycée and Boston School courses clearly shows that it is to the excess of hours of recitation as a whole, and in no small degree to the holding of mathematical studies in abeyance, that the French are enabled to accomplish what they do in the way of bringing their boys to college at an early age. Give to the Boston course, for instance, ten-per-cent increase of recitations, plus the difference existing at present between the respective hours given to mathematical studies in the lycée and Latin School courses, and we have 1,426 hours. This is more time than is at present devoted to Latin, in the Boston Latin School, during its entire six years' course. It still more closely represents the difference in the respective hours given in the two countries to modern languages and drawing, with the hours of the entire course in philosophy added. It clearly follows—reversing the point of view—that Harvard has but to slightly reduce its requirements in mathematics to the French lycée standard, to enable it to obtain from its matriculates —those coming at least from the Boston Latin School—not only the attainments in philosophy considered so desirable by its president, but also considerable proficiency in such other branches of the French programme as its honorable faculty may "elect" to receive.

With the present public sentiment, and especially in view of the present requirements in mathematics on the part of American colleges, it is not probable that we can look for a reduction in mathematical studies in our classical preparatory courses to the point exhibited by the programmes as existing in France. But

that the protest against the excessive and unnecessary time given to mathematical instruction in all our schools which has begun, will continue, none can doubt. As is well known, no primary or secondary school programme of this country can be scratched without revealing an omnipresent Tartar known as arithmetic. This mathematical Cossack is ever found firmly settled in his saddle, and foraging for subsistence hither and yon, upon friend and foe alike. The result is, that in the classical preparatory school the boy is hampered and handicapped by serious mathematical studies which absorb time that he could more profitably devote to his mother-tongue, to modern languages, and to science studies. On the other hand, in the scientific or English courses, the pupil fitting for the scientific school, or for business, is forced to take unwelcome draughts of Latin. These last are somewhat diluted, it is true, and are given perhaps on the general principle entering into the administration of certain family medicines, viz., that if not of any direct service to the patient, they can do him no possible harm. But in point of fact, while as a rule the Latin given in these brief courses can be of little or no value to a pupil fitting for the scientific school, time is taken from subjects having a direct personal bearing on his future career. It is interesting to note how, in France, this feature of instruction is managed.

A French boy having passed through the grades of the lycée classique, as exhibited in the preceding table, and intending to devote himself to a literary profession, proceeds without further ado to his examination for the *baccalauréat ès lettres* wherein mathematics plays but a subordinate part, as is indicated by the small percentage of time given it in the lycée course. But, for the benefit of graduates designed for the national schools, or for those who prefer to present themselves for examination for the *baccalauréat ès science* instead of *ès lettres* post-graduate lycée mathematical courses are instituted. The *classe de mathématiques élémentaires*, for instance, has for its object the study of matters comprised in the programmes of the *baccalauréat ès sciences*, as well as those of the military (Saint-Cyr), the naval, and forestry schools and the central school. The curriculum of this class devotes seven and a half hours per week to mathematics, four and a half hours to science studies, two each to the mother-tongue, Latin and modern languages, three hours to history and geography, one hour to philosophy, and four hours to drawing. This course is of but one year. It is usually taken by pupils from the *classe de rhétorique*, but may be taken by pupils from the *classe de philosophie* who wish to review and increase their mathematical attainments. A much stiffer and more comprehensive drill in mathematics is afforded by the *classe de mathématiques spéciales*. This course is also of but one year. The instruction

given in this class has for its object the preparation of pupils who have completed the lycée course, and who purpose entering the polytechnic, the superior, or the central schools. None are admitted to this course who have not previously manifested an aptitude for it. The hours of recitation per week are, mathematics eleven hours, descriptive geometry three hours, physics and chemistry five hours, natural history three hours, French language two hours, modern languages two hours, history and geography three hours, and drawing two hours; total, thirty-one hours.

The instruction to-day given in France under the name of *l'enseignement secondaire spécial* has found a secure footing only after many years of violent discussion and constant opposition. Its career, however, has been steadily advancing and gaining in public consideration ever since its organization in 1865. Its programme was extended and revised in 1881, and in 1886 it was organized on its present basis. The courses of study have been framed with especial reference to the requirements of a large class of pupils of good social position, who have neither the desire, the tastes, nor perhaps the leisure for long years' study of dead languages. It is a response to the needs of a large class for a preparation for actual life in various careers, which the classical courses are incapable of giving. The school is in a sense the Realschule of the French, differing from its German congener, however, by the entire elimination of Latin from its programme. The course comprises six years of study, crowned, at its successful termination, by the diploma of *bachelier de l'enseignement secondaire spécial*, the possession of which entitles the holder to admission to the examinations for the *baccalauréat ès sciences*, for the military school of Saint-Cyr, and, with the exception of the Polytechnic School, which still holds to its classical requirements, to other national schools with requirements of a general similar character.

However interesting, as an illustration of French school methods, the curriculum of the secondary special schools may be, the severity of the course, as a whole, renders it unlikely that it will ever be very closely imitated in this country. The recitations here range from twenty-five to twenty-nine hours per week, giving, for the whole course, 6,360 hours, against 4,360½ hours in the American representative of the same type of school.* The official

* As the secondary special schools of France occupy about the same place in the French system as the upper classes of grammar schools and the English high schools occupy in ours, the French programmes of these schools have been brought by the writer into comparison with a typical American school—the courses of the two upper classes of the grammar schools and those of the English High School of Boston being employed as a fair American representative.

programme shows that the instruction of these 6,360 recitation hours are distributed as follows: Mother-tongue, 1,000; modern languages, 1,160; history, 360; geography, 280; mathematics, 1,080; science studies, 960; drawing, 960; penmanship, 160; book-keeping, 80; morals, 40; legislation, 80; political economy, 40; philosophy, 160. The ages of the pupils average eleven years in the first and sixteen in the last class. The recitation hours of a pupil passing through the last two grades of the grammar school, and the four years' course of the English High School in Boston are, barring certain changes on account of options, as follow: Mother-tongue, 1,111½; modern languages, 494; history, 570; geography, 152; mathematics, 722; drawing, 760; book-keeping, 95.

Here, again, as in the case of the French classical lycée course, the instruction in the mother-tongue is found to be less than in the American representative school. The hours devoted to modern languages (1,160) are, in fact, somewhat in excess of those given to French (1,000), and, it may be added, are in most marked contrast to the time allotted to the same study in the Boston High-School programme (494), even after the latter has received a credit under this head for a certain number of hours that in point of fact are used by many pupils for Latin.

Mathematics, which, as has been seen, plays but a subsidiary *rôle* in the classical lycée course, in the secondary special course assumes more prominence comparatively, the average being 4½ hours against 3½ hours' recitation per week in the typical American programme. Yet even here it is not up to what may be termed the United States standard. A tabulated exhibit of the hours of the classical courses of the two countries shows that an average of only one hour and fifty minutes per week is given to mathematics in the classical lycée course, compared with an average of three hours and forty minutes in the Boston classical school course. A comparison of that course with the French secondary special programme develops also the fact that a typical American classical school not only devotes more hours to mathematics than the French consider essential for a preparatory scientific course, but also exhibits the further surprising fact that the Boston English High-School course, with two years of grammar-grade school prefixed to it, actually gives less time to mathematics than is devoted to that study in the six years' course proper of the Latin School. And this is not by any means peculiar to the Boston school courses. The programmes of other schools exhibit a treatment of the mathematical subjects quite similar. At Phillips Exeter precisely the same number of hours is given to mathematics in the classical and scientific courses. At Williston, even after adding the course in surveying to the mathematics, the per-

centage of the latter to the whole course is less than on the classical side.

From the data here given it seems clear that if we are to hope to put our schools on anything like an equality with those of France, to say nothing of those of other civilized countries of the world, certain modifications of our school programmes have certainly to be made. First and foremost among those changes there would seem to be indicated a need for a certain specialization of our school courses with reference to the different demands made upon the schools by different classes of pupils. That our schools of primary and secondary grade, as they stand to-day, do not respond to the varied requirements of American society, seems quite obvious. The complaint of President Eliot sufficiently indicates their shortcomings, so far as a preparation for college is concerned. For many years professors and teachers at scientific and technical schools have mourned the dearth of preparatory schools that should give them pupils not handicapped by great deficiencies in training of the powers of observation. Business men are quite unanimous in their belief that the schools do not afford a satisfactory training for commercial pursuits, while he who runs may read their many deficiencies for the constantly increasing class of pupils whose period of school life terminates in the grammar grade.

The main cause of the present stage of development of the school system is not so deeply hidden that one has to search long for it. The average American school programme at the present time is simply a living illustration of a development, on American lines—influenced and modified by national characteristics—of the old educational theory that literature and language are the basis of all mental culture and training. The educational structure reared on this theory, beset and more or less damaged by modern assaults, has been repaired here and patched there, but the old framework and the old foundations have ever remained to cramp intelligent reconstruction and practical reform. The result is in the main a hotchpotch with which no one is thoroughly satisfied. It would seem to be a clear case of the old house repaired and refurnished, until it is satisfactory to no one. It is passing strange that the school system of the United States, in respect to its want of specialization, should stand almost unique among the many examples of the national aptitude in adopting means to ends. In business life, in professional life, in industrial pursuits, our nation has shown itself peculiarly clever in its concentration of labor in systematic, well-defined channels having special reference to the results to be attained. Yet, when we come to compare our school programmes with those of other nations, we not only find that we do not do as much school work,

nor as satisfactory work, but that what we do is done in an antiquated and unscientific manner. In France, for example, we find a school system that in its superior primary course gives to the child of the humblest artisan not only a solid foundation in all essentials of mother-tongue instruction, but, by means of its complementary courses, in manual training and modern languages as well. We likewise find a clean-cut, well-defined course in the special secondary schools for the child who seeks preparation for commercial or professional life by modern methods; while, by the systematic arrangement of its classical lycée course, results are achieved which excite the admiration and envy of the president of one of our most honored universities. Turning to our own programmes, we find what can only be characterized as a more or less futile effort to build on one foundation several distinct structures, each one of which is diverse in the special ends sought to be accomplished. In our effort to do everything, we have failed to do anything sufficiently well to entitle it to favorable comparison with the results attained by a more skillful apportionment of labor.

We can also learn from the French programmes that if American schools are to accomplish results comparable with those attained in France, American children have not only to work on more specialized lines, but have also to work more. There can be no doubt that the outcry against "long school hours" and "home study," which for many years past has been so resonant in this country, has seriously affected the efficiency of our schools. As the exhibit of school programmes here given shows, the average hours of recitation in American fitting schools are very considerably less than in those of France. And those of France are to about an equal degree less than the hours of the German gymnasia and Realschulen. It is full time that a halt be called on the further progress of this absurd clamor. The idea that a healthy American boy, between the age of eight and fifteen years, let out of school, as he generally is in these days, at from one to two o'clock, should not do a certain amount of systematic study at home, certainly can but be characterized as absurd. It is probable that but few persons, who have not made special inquiry in regard to it, appreciate the extent to which this sentiment against out-of-school study now prevails in this country. If it has had the effect of crippling the public schools, it may be said that it has really paralyzed many private ones where this feeling is pandered to. The advanced age of pupils entering the private fitting schools, as well as the advanced age of college matriculates, is to a great extent due to this disinclination of parents to submit their children to regular systematic study in their earlier school life. In collecting the data for this paper the writer has been pleased to

ascertain that on the part of certain endowed home fitting schools established on recent foundations, direct efforts are being made to counteract these deficiencies of earlier years by a systematic regulation of pupils' time—both as regards study and recreation. The result, as could be anticipated, is a marked broadening of the school course, as well as a decided decrease in the ages of the senior class pupils. It is because of the possibilities in this direction, as well as to respond to the rapidly increasing demand in the United States for them, that thoroughly good preparatory home schools, which shall fit boys for college and scientific school in a rational manner, are now especially in request. The average home school that fits for everything or anything, and that is a fraud from its glossy catalogue to its ornate diploma, is sufficiently well known to the average parent, and is not here alluded to. The home schools now needed to meet our modern requirements can have an existence only by virtue of some man or men willing to liberally endow them. It would seem, too, that the ideal preparatory home school should embrace at least six years of instruction. It should be fully equipped and prepared in all respects to respond thoroughly to the three distinct demands that are now made upon the modern fitting school, viz.: (1) preparation for college with all the maximum requirements in the classics; (2) preparation for college without Greek, but with adequate modern language and science-study substitutions; (3) preparation for the scientific school without Latin or Greek, but with equivalent and honest substitutions of somewhat increased mathematical instruction (as compared with the classical branches), together with modern languages and science studies, so taught that in all respects of severity of course they shall equal in disciplinary results the drill given in the classical courses.

To the response that may be made, to the effect that we already have preparatory schools doing precisely this work, and doing it well, it is claimed that the few facts presented in connection with this paper are in themselves a sufficient refutation. There is another point. The writer would be among the last to impugn the ability, the conscientious devotion, the peculiar fitness, even, of the heads, and, generally speaking, of the staffs of these classical schools, for he has the highest appreciation of them. But the fact remains that, with hardly an exception, the faculties of the old classical preparatory schools that have been erected on the old endowments seem to be incapable of giving absolutely fair and honest treatment to their so-called preparatory scientific or English adjuncts. They are bound hand and foot in the old traditional bonds. By reason of their educational bias they are precluded from yielding a hearty, enthusiastic response to any demand that a classical curriculum does not meet. In point of fact, why should

they? They have personally no faith whatever in the real value of any training except that gained by the study of the classics. They appreciate that the scientific course is but a graft on the old trunk, made in great measure for the pecuniary advantage of their establishment, and in response to a popular demand, which they hope and pray may soon find a speedy death. They have no hesitation in proselytizing in the ranks of the brighter "scientific" pupils sent them, for the benefit and glory of the "full rounded course"—in embryo. Here again they are justified, for the preparatory scientific courses are in fact but indifferent patchwork compromises between the claims of the past and the demands of the present. These courses really do give no thorough secondary school work in any one subject, except possibly mathematics. With an apparently semi-superstitious feeling as to the mysterious results produced on the human mind by communion with a Latin grammar, for even a limited period, little dabs of Latin have been introduced into these courses. This study extends in the scientific course of some preparatory schools through one year, sometimes two, rarely three years. With no desire whatever to depreciate the undoubted value, to certain pupils, of an honest, *bona fide* study of the classical languages, continued for years, it is submitted that these cursory courses of Latin can give no results in any way commensurate with the time expended on them. In Germany the classicists have ever stoutly maintained that any reduction of hours devoted to Latin in the gymnasium course would deprive it of all value; yet they there give to it nine hours per week for five years, and eight hours for four years more. In the Realschulen they devote to it eight hours a week for two years, six hours for three, and five hours for four years. The value that the German school authorities would place upon a course of Latin of three or four hours per week for one, two, or even three years, affords a pretty little arithmetical problem whose solution is respectfully relegated to the designers of these American courses. Beyond this Latin and the regulation four or five hours a week in mathematics, what else does one find in our preparatory "scientific" courses? As but few of the more modern scientific schools or schools of technology have requirements in Latin—and as one and all of them are desirous of obtaining from their matriculates all, and more than they often get, in the way of modern languages—one could properly expect that the fitting schools would afford opportunities for solid preparation in French and German. As will be seen, this demand is by no means well responded to. In the scientific courses of one prominent fitting school consulted by the writer, no instruction whatever in modern languages is given. In the programme of another of these schools—which is also the most modern, therefore lending some

encouragement to the hope of more enlightened procedure as time rolls on—we find that modern languages enter into but three of the four years' course. Leaving the modern languages, and looking at the time devoted to science studies, the same desultory treatment is found. There is encouragement to be had in the assurances of laboratories erected and in course of erection, and in the information that in some fitting schools Harvard's requirements in experimental physics and chemistry can be fully met; but, so far as the curriculum itself of the scientific course is concerned, we have but the hope of something better in the future. If one glances at the time allotted to the education of the hand by means of drawing, or if one is curious in the matter of history and mother-tongue instruction, almost equally unsatisfactory work is encountered. Very properly, any intelligent parent, studying such courses with a view of submitting to one of them a boy whom he has decided to educate on modern methods, hesitates. It is not strange that in his extremity he finally concludes that a serious, well-defined course in the ancient languages is of more value than the *olla podrida* preparation presented him on the "scientific" side. As this is precisely what the makers of the programmes themselves believe, this conclusion is applauded—and there is rejoicing over the rescue of another boy from a "one-sided education"!

A comparative examination of French and American preparatory school programmes, therefore, at least yields this much; that our educational methods are in great need of thorough revision if we are to hope to stand well alongside the French in all that pertains to judicious preparation for college, for scientific school, or for the general demands of modern life. This examination further shows that we stand in pressing need not only of fitting schools that meet these demands as they exist to-day, but so untrammeled and free from all sort of sectarian or educational bias that they can freely expand and respond to the demands that will assuredly follow as years roll by, and colleges and universities still further yield to the influences that are slowly but surely liberating them from the traditions of the past. An honest home fitting school, firmly founded on the principle of responding to the demands as they exist to-day—not as they existed a century or two ago—sufficiently endowed to render it free to maintain firmly all the requirements of its different rational courses of instruction, seems to be the great educational need of the day. As the weakest link of our educational chain lies most undoubtedly in the earlier years of the preparatory course, this school should be prepared to take pupils at twelve years of age; it would be better if they could be taken at ten, and the course be made to embrace eight years instead of six. It should be a home school, for the reason that, with

the prevailing habits of American family life, it is becoming with us every day more and more impossible to obtain from pupils the proper amount of work, associated with the proper *régime* as to exercise and recreation—and diet even—so long as they remain under the parental roof. Such a school could not fail to soon stand as an exponent of the development of a higher, better, and truer secondary education. It would be a model for the encouragement of other schools of a similar character that would soon come into existence, and it would make its impress upon the programmes of public secondary schools. Any man of wealth who is animated by the ambition of sending his name down to a grateful posterity linked with a noble educational benefaction, could not to-day find a more deserving field for the investment of a spare million than in the founding of such a school. To the colleges, to the universities, to the schools of industrial science, would the money thus invested be of as great benefit as if donated directly to them. For, as the gentle rain sinking far down into the earth among the rootlets refreshes and revives the mature tree, so would a preparatory school of this character give to the higher institutions of learning strength at a vital point where it is peculiarly needed.

SCENES ON THE PLANET MERCURY.*

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NO one of the planets that were known in ancient times is so difficult to observe as Mercury, and none presents so many obstacles to the study of its orbit and physical constitution. As to its orbit, Mercury is the only planet the course of which seems even now to have partly cut loose from the laws of universal gravitation, and the theory of which, although well built up by the genius of Leverrier, is still in considerable disagreement with the observations. The little we know of its physical construction is derived from the observations made a hundred years ago by Schroeter at Lilienthal. A telescopic examination of this planet is really a difficult affair. Describing a small orbit around the sun, Mercury is never seen so far from it as to make it possible to observe it, in temperate latitudes, in the full darkness of night. It is rarely possible to observe it in the twilight before sunrise or after sunset; it being then so near the horizon and so affected by the agitations and unequal refractions of the lower strata of the atmosphere that it usually presents itself to the telescope with

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an uncertain and flaring aspect which appears to the naked eye as a strong scintillation. For this reason the ancients called it Στίλβων, or the scintillating star. No other resource is left than to essay observations in broad daylight, in the presence of the sun always near, and in an always illuminated atmosphere.

Some efforts I made in 1881 persuaded me that it was possible both to see the spots of Mercury and to get sufficiently connected and continuous observations of them in broad daylight, and I decided in the beginning of 1882 to make a regular study of this planet. During the eight years since then, I have had Mercury in the field of my telescope several hundred times; often, it is true, with little profit and at the expense of great loss of time, either because of the agitation of the atmosphere, which is often strong during the day—especially in the summer months—or on account of the insufficient transparency of the air. But by patience I have succeeded in seeing the spots on the planet one hundred and fifty times with more or less precision, and in making also fairly satisfactory drawings of them, employing at first, for the purpose, our eight-inch Merz equatorial, but afterward our great eighteen-inch Munich instrument.

I found the rotation of the planet quite different from what it has hitherto been supposed to be, on the basis of insufficient observations made with imperfect telescopes a hundred years ago. I may describe it in a few words by saying that Mercury revolves around the sun in the same manner as the moon revolves around the earth. As the moon's journey around the earth is performed in such a way that it always shows nearly the same face and the same spots, so Mercury, in traversing its orbit around the sun, constantly presents nearly the same hemisphere to that source of light. I say nearly—not exactly—the same hemisphere. For Mercury is subject, like the moon, to the phenomenon of *libration*. In observing the full moon, even with a small telescope, we remark that the same spots generally occupy the central regions of its disk; but, if we study them and their distances from the eastern and western borders more minutely, we shall soon perceive, as Galileo first did about two hundred years ago, that they oscillate to a considerable degree, now toward the right and now toward the left—exemplifying the phenomenon called *libration in longitude*. This arises from the moon's directing one of its diameters perpetually and almost exactly, not toward the center of the earth, and not toward the center of the elliptical lunar orbit, but toward the one of the two foci of its orbit which the earth does not occupy. To the observer occupying this point, the moon would consequently always present the same appearance. But to us, who are at a mean distance of forty-two thousand kilometres from that point, the moon presents somewhat different aspects

according to the time when we look at it, sometimes showing us a little more of its eastern, sometimes a little more of its western, regions. Mercury presents itself to the sun in different phases of its cycle in a similar manner. It constantly directs one of its diameters, not toward the focus of its elliptical orbit which is occupied by the sun, but toward the second focus. These two foci being distant from one another not less than a fifth of the whole diameter of the orbit of Mercury, the libration of the planet is enormous. The point that receives the rays of the sun vertically changes its place on the surface of the planet, and performs an oscillatory movement along the equator forty-seven degrees in amplitude, or through more than one eighth of the equatorial circumference. The whole duration of this oscillation, including the going and returning, is equal to the time employed by Mercury in traversing its orbit, or about eighty-eight terrestrial days. Thus Mercury stands oriented toward the sun like a magnet toward a mass of iron; but this orientation is not constant to the point of excluding a movement of oscillation of the planet to the east and to the west, like that which the moon performs toward us.

This oscillation is of great importance for the physical condition of the planet. Suppose, for instance, that it did not exist, and that Mercury always turned the same hemisphere to the light and heat of the sun, the other hemisphere remaining plunged in perpetual night. The point of the surface situated at the central pole of the illuminated hemisphere would have the sun eternally in the zenith; the other points of the planet accessible to the solar rays would have the sun always at the same point in their horizon, at the same height, without any apparent movement, without any perceptible change; consequently, no alternation of night and day, no variety of season; the stars eternally invisible because of the perpetual presence of the sun; and, Mercury having no moon, we can hardly imagine how the inhabitants of those regions, condemned to an endless day, could find a means of regularly computing time.

Such are, in fact, nearly the conditions that prevail in Mercury, but only approximately. The oscillating movement of the Mercurial globe as toward the sun would be attributed by an observer on the surface of the planet to the sun, as we attribute to the sun the diurnal movement which really appertains to the earth. To us the sun seems to circle regularly from east to west, defining in twenty-four hours the period of day and night; to the observer on Mercury, the sun will describe a back-and-forth movement through an arc of forty-seven degrees in the celestial vault, while the position of the arc as toward the horizon will always be the same. The complete period of the double oscillation will com-

prise almost exactly eighty-four terrestrial days. According as the arc of solar oscillation is all above the horizon of the observer or all below it, or partly above and partly below it, there will be different appearances and a different distribution of light and heat. In the regions, covering three eighths of the planet, where the arc is all below the horizon, the sun will never be seen, and the darkness will be perpetual. Thick and eternal night will reign there, except perhaps from the accidental appearance of some light produced by refraction and atmospheric glows, or phenomena like the aurora borealis; together with the light emitted by the stars and planets.

Another part of Mercury, including also three eighths of its surface, will have the arc of oscillation all above its horizon, and will be continually exposed to the rays of the sun, without any other change than the variations in the obliquity of the rays through the different phases assumed during the period of eighty-eight days. Night is absolutely impossible. In other regions, covering a quarter of the planet, in which the arc of oscillation is partly above and partly below the horizon, there will be alternations of light and darkness. In these privileged regions the period of eighty-eight days will be divided into two intervals, one characterized by a continuous light, the other by darkness; the two intervals will be equal in some places, of different length in others, according to the position of the place on the surface of the planet, and the length of the part of the solar arc which appears above the horizon.

The possibility of organic life in a planet constituted after this manner depends on the existence of an atmosphere capable of distributing heat into different regions, in such a way as to diminish the extremes of heat and cold. Schroeter, a hundred years ago, suspected the existence of an atmosphere round Mercury; my observations afford more definite indications of it, and affirm its existence with a much greater probability. The spots of the planet are most clearly visible when they are in the central parts of the disk, and grow dimmer and ultimately disappear as they approach the border. I have been able to assure myself that this phenomenon is not merely due to the greater obliquity of the perspective, but is because some obstacle is really presented to the view of spots situated in such positions. That obstacle can hardly be anything else than the greater extent of atmosphere that the light-rays have to traverse in coming from the edges than from the center of the disk. We have, therefore, reasons for believing that the atmosphere of Mercury is less transparent than that of Mars, and more nearly like that of the earth. The circular contour of the planet, moreover, in which the spots become less visible, always appears more luminous than the rest, but often irregularly

luminous, more so at some points than at others; and sometimes we can see on its borders bright white regions that remain in sight several days in succession, but are generally changeable, and show themselves sometimes in one place and sometimes in another. I attribute these phenomena to condensations going on in the atmosphere of Mercury, which reflects more light into space the more opaque it becomes. Similar white regions are also often seen in the interior of the disk, but they are not so brilliant there as on its border. Further, the dark spots of the planet, while they are permanent as to form and arrangement, are not always equally evident. They are sometimes more intense, at other times paler. Sometimes, also, one or another of them will become momentarily invisible. Such peculiarities can not be attributed to any other cause than atmospheric condensations similar to our clouds, which veil the ground of the planet in different degrees, sometimes in one region, sometimes in another. An observer, looking from the depths of space upon the countries of our earth covered with clouds, would perceive a like spectacle.

Very little can be said of the nature of the surface of Mercury. We must recollect that three eighths of it are inaccessible to the solar rays and to sight; on that side, therefore, we have but slight hopes of ever learning anything certainly. It will also be hard to gain a correct and sure knowledge of the part we can see. The dark spots, even when they are not clouded, usually appear under the form of extremely thin trails of shadow. In ordinary conditions they are distinguishable only at the expense of much attention and weariness. Under the best conditions they have a brown, warm tint, like that of sepia; of a tone very indistinct upon the general color of the planet, which is usually of a clear rose bordering on copper. Forms or bands so vague and diffuse, with indistinct borders, always leaving a place for arbitrary definition, are not easily represented in a satisfactory manner. Still, I believe the indeterminateness of outlines is, in the majority of cases, only apparent, and a result of the insufficient optical power of the instrument; for the more perfect the view and the finer the image we get of the shadows, the more do we find them disposed to break up into a multitude of smaller details. By employing more powerful telescopes, they could doubtless be resolved into more reduced forms.

While it is so hard to make a good study of the dark spots of Mercury, it is not easy to express a well-founded opinion upon their nature. They might be attributed to the different materials composing the solid surface of the planet or to its structure, as we know is the case with the moon. But if we are disposed to consider them as in some way resembling our seas, and to suppose the existence of an atmosphere around the planet, with condensa-

tions and precipitations, I do not know of any decisive arguments that can be opposed to the opinion. The spots are not gathered in large masses, but are disposed in areas and zones of small extent; are greatly ramified, and alternate with considerable uniformity with clear spaces. We may, therefore, conclude that no vast oceans or great continents exist on Mercury; but that land and sea interpenetrate one another and give rise to conditions very different from those which exist on the earth, but which may be more desirable.

Mercury is a world that differs from ours as much as Mars does. The sun lights it and warms it much more intensely than it does the earth, and in a very different way. If life exists in that world, it is doubtless under conditions so different from ours that we can hardly imagine them. The eternal presence of the sun, darting its rays almost vertically on some regions, and its perpetual absence in the opposite countries, would seem intolerable to us. And yet, if we reflect upon it, we shall remark that such a contrast would produce a more rapid, more powerful, and more regular atmospheric circulation than that which spreads the elements of life over the earth; and it possibly is brought about in this way that as complete and even perhaps more perfect equilibrium of temperature is produced on the whole planet than with us.

Mercury, by directing the same face toward the sun during its whole revolution, is peculiarly distinguished from the other planets, all of which the length of whose rotation has been determined, turn round their axes in a few hours. This mode of rotation, however, which would be unique among the planets, seems common enough among the satellites. All testimony is to the effect that our moon has always conformed to it. The first three satellites of Jupiter probably behave in the same way, and the observations of Auwers and Engelmann demonstrate that the fourth does so. Cassini verified the same fact for Japhet, the eighth satellite of Saturn. It may, therefore, be considered the rule among the satellites, while it is an exception among the planets.

The exception may probably be attributed to the proximity of Mercury to the sun, and perhaps also to the fact that it has no satellites; and depends, I think, on the way Mercury was formed when the solar system took its present shape. The peculiarity constitutes a new datum to be added to those which astronomers will have to take account of in studying solar and planetary cosmogony.—*Translated for the Popular Science Monthly from a French version by* F. TERBY *in Ciel et Terre.*

ARTIFICIAL HONEY AND MANUFACTURED SCIENCE.

By ALLEN PRINGLE,
PRESIDENT OF THE ONTARIO BEE-KEEPERS' ASSOCIATION.

WE are often told that this is a scientific age, and the statement is undoubtedly true. The world now more than ever before looks to science as a secular if not a spiritual guide. However much their speculations may be questioned and controverted, the scientific book and the scientific man are popularly accepted as authority, at least on matters of physical and historical fact. The veracity of science therefore is, or ought to be, above suspicion. How careful, then, ought the teacher and exponent of science to be that his assertions are true; that his alleged facts are facts; and that even his speculations are free from the appearance of dogmatism! He needs to be especially particular when writing for the general public, for people untrained in science will accept his statements as expert testimony. Errors will thus be sure to mislead his readers, many of whom are without the knowledge that would enable them to discriminate between the true and the false in his assertions.

In The Popular Science Monthly for June, 1881, appeared an article on Glucose and Grape-Sugar, by Prof. H. W. Wiley. In that article the following unfortunate statement was made: "In commercial honey, which is entirely free from bee mediation, the comb is made of paraffin, and filled with pure glucose by appropriate machinery." To say that there was not one word of truth in that extraordinary assertion is the short and proper way to put it, and that is exactly what I undertake to say. There was not a tittle of evidence that any such honey had ever been made up to that time, nor is there a particle of evidence that any such honey has since been made.

Nevertheless, this vile slander on an honest and honorable industry has done incalculable injury to bee-culture in America, if not throughout the world. A lie is said to travel half round the world while the truth is getting ready to start, and this one proved no exception. Though contradicted and refuted over and over again, it still lives and is still going. Newspapers still keep iterating and reiterating Prof. Wiley's slander, but they seldom publish a correction. Thousands of people, common and uncommon, still believe that scientific yarn that comb-honey is manufactured throughout without "bee mediation," and why shouldn't they? The former believe it because the newspapers say so, and the latter because the magazines and encyclopædias say so; for it is a fact that this itinerant fiction has actually found a place in

the American Cyclopædia and the American supplement to the Encyclopædia Britannica. In justice to the latter, however, it must be said that the British work, whose publishers repudiate the American supplement, contains nothing of this.

Here is what the American Cyclopædia says on the subject: "Glucose is very extensively fed to bees, which eat it with great avidity, and store it away unchanged as honey. It is also put up directly in trade as honey—with which bees have had nothing to do—being put by means of appropriate machinery into artificial combs made of paraffin" (page 834, vol. viii, edition of 1883).

The American supplement to the Encyclopædia Britannica has this information on the subject: "Honey is manufactured on the same plan, only here the bees are employed to assist in the fraud. They are furnished with a supply of starch-sugar, which they store in their combs, when these combs are also fraudulent, being made from paraffin and furnished to the bees, who fill them with glucose and cap them with genuine wax. It is difficult to see how the art of adulteration could be carried further" (page 41, vol. i, Hubbard Brothers, Philadelphia and New York, 1885).

Argument and refutation failing to kill the falsehood, the editor of Gleanings in Bee-Culture—a responsible man financially—offered a reward of one thousand dollars to any one (including Prof. Wiley) who would produce some of the so-called "manufactured" honey, or designate the place where it was made or could be found. This offer is still open and good. The writer of this article also offered through the press a reward of one hundred colonies of bees (equal to about one thousand dollars) to any one who would produce some of this "artificial honey." This offer also is still open and good. None, however, has ever been produced. No one has yet come forward to claim the cash or the bees.

Prof. Wiley had supplemented the assertion above quoted with the following additional information, probably to encourage the manufacturers: "This honey" (that is, the manufactured article) "for whiteness and beauty rivals the celebrated real white-clover honey of Vermont, but can be sold at an immense profit at one half the price." Now, had that business of honey manufacture been as practicable as profitable, the temptation to embark in it would have been almost too much for human nature to resist. But it seems nobody went in, while nearly everybody believed that other bodies were in.

However, Nature's dearth is likely to produce conviction where facts, arguments, and rewards failed to do so. The seasons of 1887 and 1888, especially the latter, were unpropitious for the "busy little bee," and yielded but little honey. The crop was a

general failure, not only in America but in Europe. The modicum of honey produced, especially of comb-honey, was soon exhausted, and the dealers as well as consumers, North, South, East, and West, were crying out for honey. The producers were inundated with letters and orders which they could not fill. Now, here was *the* grand opportunity for the manufacturers of "artificial honey." If the article could be sold "at an immense profit at half the price" of the genuine article, as Prof. Wiley assures us, these bogus manufacturers could have coined money—there were "millions in it" apparently. But they failed to appear. The glucose was available, the paraffin ditto, and the "appropriate machinery" ought, in the interval under the law of progress, to have become still more "appropriate" and perfect in its work; but, strange to say, the famine of honey continued. The tempting prices were offered in vain. Not a pound of the stuff ever "materialized," so far as anybody could find out. Nor was this gap in the extracted honey, caused by the drought, filled by any artificial substitute, which also goes to prove that the prevalent notion that honey is extensively adulterated has very little foundation in fact. Considering the comparatively low market prices of honey the past few years, and the facility with which the genuine article can be produced in modern scientific bee-culture, adulteration would hardly pay for the trouble.

That there is but very little adulteration either of comb or extracted honey may be safely asserted. The prevalent popular belief to the contrary may be accounted for in two ways—by the prevalent ignorance of the character and what I might call the habits of honey, and by the erroneous teachings and misleading reports of the authorities under review. While it may be said, in general terms, that honey chemically consists of sugar and water, in the proportion usually of about seventy-five per cent of the former to twenty-five of the latter,* these elements vary so much in their proportions in different grades of honey gathered from so many different flowers at different seasons of the year that there is no sure test, chemical or other, of honey. Even the polariscope, but recently considered a certain test of its purity, and still so considered by some analysts, is found to be uncertain and unreliable. While generally in pure honey the ray of light is turned to the left, some samples, equally pure, though perhaps stored rapidly and capped prematurely, may contain so much cane-sugar that the ray is turned to the right. Hence the mistakes of chemists, relying upon the integrity of the polariscope, in passing upon the purity or impurity of honey. They have

* According to C. Tomlinson, F. R. S., F. C. S., dextrose thirty-eight per cent, levulose thirty-six, water twenty-two, and the remaining four, salts, wax, pollen, gluten, and aromatic and coloring matters.

pronounced samples adulterated which were known to be the pure products of the flowers gathered by the bees. Every apiarian specialist knows that during the course of one good honey season, beginning with the early spring bloom of willow, maple, fruit, etc., and ending with the fall bloom of golden-rod, buckwheat, etc., he can get nearly a dozen different grades or kinds of honey—in color from the very light, almost transparent linden to the turgid and black buckwheat, and in flavor from the mild and delicious sweet to that which is strong, rank, and quite unpalatable to some tastes. Let a person with no special knowledge of honey be presented with the former for his sight and palate, and then with the latter, and, ten to one, he will declare that the one sample is not honey at all, but a vile imitation. Then, again, good, pure honey, through mismanagement, may become so deteriorated in quality and altered in taste as to at once provoke suspicion of adulteration.

Granulation was also regarded as a sure test of the purity of honey, but it is not so, as some pure grades, containing only the non-crystallizable sugar, will not granulate; while other samples mixed with glucose will granulate. The light-colored and best grades of honey will be fine-grained in granulation, while other grades will be coarse-grained and present the appearance of sugar for certain to the uninitiated.

When an honest man falls into an error, he is always willing to correct it as soon as it is pointed out to him and proved to be such. Prof. Wiley was expected to do that much at least toward repairing the injury he had wittingly or unwittingly done the whole fraternity of bee-keepers. But Prof. Wiley failed to do so, so far as the public knows. He neglected—I may safely say refused—to make the *amende honorable.* The apiarists became incensed, indignant, and demanded proof of his assertion or a retraction. The professor of science vouchsafed neither the one nor the other. Finally, after years had elapsed, being still hotly pursued by the apiarists and bee journals, especially the American Bee Journal, Prof. Wiley did manage to make an explanation or "statement"; which, however, in no way improved his position before the public either as an honorable man or a professor of science. About seven years after uttering the slander to the world, he speaks, and makes this astounding admission:

"At the time, I repeated this statement more in the light of a pleasantry than as a commercial reality, for I did not believe that it was possible commercially to imitate the comb." (Letter dated Washington, D. C., May 29, 1888, addressed to W. M. Evans, and published in the American Bee Journal of June 13, 1888.)

In this attempted justification of himself Prof. Wiley says he had heard from a friend of his (now deceased) that comb-honey

was manufactured in Boston as stated above. On the strength of that, and that alone, he made the deliberate assertion which I have quoted from The Popular Science Monthly.

Now, after reading and re-reading the context in The Popular Science Monthly article, I find not a shadow of evidence that this statement was meant for a fiction and not for a fact. It is given seriously and deliberately, along with other alleged scientific facts, with no intimation or indication whatever of its spurious character. The readers (and no doubt the publishers) of The Popular Science Monthly accepted the statement in good faith as a fact. The newspapers, of course, accepted it as true from so respectable an authority as The Popular Science Monthly, and even the encyclopædias finally took it in. Indeed, nobody, it seems, took it as a fictitious "pleasantry," or even dreamed it was meant for one, till the exigencies of the case required such a construction (or misconstruction) from the author himself. If it really was meant as a harmless scientific squib, with no *malice prepense*, the question arises, How is it that the professor neglected to set the matter right when he found that everybody was taking his joke seriously, to the great detriment of an important industry, and the calumnious aspersion of honest honey-producers?

Another example of spurious science is now before me. The Medical Standard for June, 1889, contains a leading article on Embryology, by a learned New York doctor, in which we are gravely informed that "a worker bee is a highly organized creature, with a well-developed brain, wonderful sense-organs, intricate muscular apparatus, and yet it is an offspring of an unimpregnated queen bee." Now, this is all well put and quite true, except the last clause, which is just the opposite of the truth. Any apiarian specialist could have told the doctor that while it is true that the virgin queen bee lays eggs which produce drones or males, she never deposits eggs which produce females—that is, workers and queens—until after she is impregnated by the drone. Hence, the worker bee is *not* "an offspring of an unimpregnated queen bee."

While it would be obviously unfair and unreasonable to hold the Monthly morally responsible for the specimen of *wily* science and its results to which this article refers, it is, perhaps, not entirely free from blame in allowing the matter to rest uncorrected so long. I take the liberty of here suggesting to publishers of encyclopædias and scientific works the wisdom of first submitting doubtful points and dubious assertions, made by men outside their special departments, to *practical* men in such departments, whether the latter be learned or unlearned, for the knowledge of an unlearned man touching his own particular line of business

(even the science of it) may exceed that of the scientist both in accuracy and extent. Such a course would often save the specialist from humiliation, and spare the public the infliction of some very queer science, which, not infrequently, fails to dovetail with every-day facts.

WALLACE ON "DARWINISM."

By the LORD BISHOP OF CARLISLE.

I HAVE read with deep interest, as doubtless have many other persons, Mr. Wallace's volume entitled Darwinism, which appeared in the month of March last year. No one has a higher right to teach the world on this recondite subject; and when it is borne in mind that Mr. Wallace was himself an independent discoverer of the principle associated with the name of Darwin, and that, nevertheless, no sentence indicative of rivalry or jealousy—in fact, no sentence laying claim to original discovery—occurs throughout the book, it is impossible not to be struck with a feeling of reverence toward a writer who combines such remarkable ability with no less remarkable modesty. Reference is made to this point in an article in the Contemporary Review (August, 1889) by Prof. Romanes, who writes thus:

> It was in the highest degree dramatic that the great idea of natural selection should have occurred independently and in precisely the same form to two working naturalists; that these naturalists should have been countrymen; that they should have agreed to publish their theory on the same day; and last, but not least, that, through the many years of strife and turmoil which followed, these two English naturalists consistently maintained toward each other such feelings of magnanimous recognition that it is hard to say whether we should most admire the intellectual or the moral qualities which, in relation to their common labors, they have displayed.

Prof. Romanes further lays stress upon the fact that, whereas opinion has lately tended, as between the two naturalists, toward Wallace and away from Darwin, there is no sign of triumph in the book.

> If ever there was an occasion (writes Prof. Romanes) when a man of science might have felt himself justified in expressing a personal gratification at the turning of a tide of scientific opinion, assuredly such an occasion is the present; and, in whichever direction the truth may eventually be found to lie, historians of science should not omit to notice that in the very hour when his life-long belief is gaining so large a measure of support, Mr. Wallace quietly accepts the fact without one word of triumph.

It is very pleasant to read this record of forgetfulness of self in the feeling of complete devotion to the cause of science and of truth; possibly instances of such self-forgetfulness are not so uncommon as they are sometimes supposed to be.

But Mr. Wallace needs no compliments from me, and it is not for the purpose of paying them that I have taken pen in hand. My purpose is rather to commit to paper certain thoughts which have occurred to me during the reading of his most interesting volume, and which it may perhaps be worth while to record. It seems to me that the publication of Mr. Wallace's work affords an occasion for taking stock, as it were, of that which the author describes as "Darwinism." It is needless to say that in the author's use of the word there is nothing vague, much less disparaging, in this term. The term is used in a certain definite sense, and is intended to express, not evolution in general, but evolution by those special processes to which Mr. Darwin believed evolution to be due. It is, I think, manifest that much advantage may accrue even from a declaration at the hands of such an authority as Mr. Wallace of what "Darwinism" is; but, besides this, it is specially advantageous, now that a quarter of a century has passed since the great revolution in thought on this class of subjects commenced, that we should know what is the real position of the controversy; there has been sufficient time for the smoke and din of the battle to pass away, and we can now form a better estimate than was possible in earlier days of the actual result of the engagement. I propose, therefore, to offer some remarks upon Mr. Wallace's volume, chiefly from the point of view just indicated; observing in general that the conclusion which seems to me to be of chief importance is this—that while Mr. Wallace holds to Darwin's views in the most important particulars, he does not regard "Darwinism" as any explanation of some of the most important phenomena which the living world presents.

This observation, however, must stand on one side for the present. The point which must occupy us just now is the actual meaning of "Darwinism," upon which possibly not a few persons have somewhat hazy notions. Let me quote Mr. Wallace:*

> In order to show the view Darwin took of his own work, and what it was that he alone claimed to have done, the concluding passage of the introduction to the Origin of Species should be carefully considered. It is as follows: "Although much remains obscure, and will long remain obscure, I can entertain no doubt, after the most deliberate and dispassionate judgment of which I am capable, that the view which most naturalists until recently entertained, and which I formerly entertained—namely, that each species has been independently created—is erroneous. I am fully convinced that species are not immutable; but that those belonging to what are called the same genera are the lineal descendants of some other and generally extinct species, in the same manner as the acknowledged varieties of any one species are the descendants of that species. Furthermore, I am convinced that natural selection has been the most important, but not the exclusive, means of modification." It should be especially noted, adds Mr. Wal-

* Page 9.

lace, that all which is here claimed is now almost universally admitted, while the criticisms of Darwin's works refer almost exclusively to those numerous questions which, as he himself says, *will long remain obscure.*

Mr. Wallace then proceeds to explain precisely what is meant by *natural selection,* and what, therefore, the Darwinian theory really is:

The theory of natural selection rests on two main classes of facts, which apply to all organized beings without exception, and which thus take rank as fundamental principles or laws. The first is the power of rapid multiplication in a geometrical progression; the second, that the offspring always vary slightly from the parents, though generally very closely resembling them. From the first fact or law there follows, necessarily, a constant struggle for existence; because, while the offspring always exceed the parents in number, generally to an enormous extent, yet the total number of living organisms in the world does not, and can not, increase year by year. Consequently, every year, on the average, as many die as are born, plants as well as animals; and the majority die premature deaths. They kill each other in a thousand different ways; they starve each other by some consuming the food that others want; they are destroyed largely by the powers of nature—by cold and heat, by rain and storm, by flood and fire. There is thus a perpetual struggle among them which shall live and which shall die; and this struggle is tremendously severe, because so few can possibly remain alive—one in five, one in ten, often only one in a hundred or one in a thousand.

Then comes the question, Why do some live rather than others? If all the individuals of each species were exactly alike in every respect, we could only say it is a matter of chance. But they are not alike. We find that they vary in many different ways. Some are stronger, some swifter, some hardier in constitution, some more cunning. An obscure color may render concealment more easy for some, keener sight may enable others to discover prey or escape from an enemy better than their fellows. Among plants the smallest differences may be useful or the reverse. The earliest and strongest shoots may escape the slug; their greater vigor may enable them to flower and seed earlier in a wet autumn; plants best armed with spines or hairs may escapé being devoured; those whose flowers are most conspicuous may be soonest fertilized by insects. We can not doubt that, on the whole, any beneficial variation will give the possessors of it a greater probability of living through the tremendous ordeal they have to undergo. There may be something left to chance, but on the whole *the fittest will survive.**

Upon this statement of what "Darwinism" is, coming to us as it does from the highest authority, certain observations suggest themselves.

In the first place, objection may be taken to the phrase, *the fittest will survive.* The phrase, if I am not mistaken, was not originally devised by Mr. Darwin, and seems open to criticism. For fitness implies something of moral superiority; you can not measure it in respect of length, or breadth, or strength, or any other quality capable of being tested by strictly physical conditions. Moreover, there is some danger of being betrayed by the

* Pages 10, 11.

phrase into the error of arguing in a circle; for, in the case of not a few creatures which have survived, it is difficult to give any good reason for their survival except upon the assumption of their fitness as proved by the very fact of their survival. Thus their fitness leads to their survival, and this survival leads to the conclusion that they must have been the fittest. Which is arguing in a circle. Still further, it is not difficult to suggest examples in which the expression, *survival of the fittest*, manifestly breaks down. Sir Isaac Newton was, as is well known, a very delicate child, difficult to rear. Suppose that Newton and a powerful navvy, or coal porter, or grenadier, had been compelled to rough it as children at Dotheboys Hall or some similar establishment, which would have survived? Not Newton; and yet it may be fairly argued that in many respects he would have been the fittest. Nor is this imaginary case an altogether unfair test of the propriety of the phrase; for it is impossible to give any true definition of fitness which shall exclude all moral and intellectual qualities, all qualities in fact which are of the highest value, and which shall simply include those elements of toughness and wiriness, and strength of sinew or stomach, which are chiefly calculated to prolong life in trying circumstances.

Putting out of consideration, however, the propriety of the language by which survival in the struggle for life, whether among vegetables or animals, is expressed, it is to be admitted that the principle indicated is a true one. That is to say, it may be regarded as admitted by all persons whose studies and natural powers render their opinion of any real value, that modification by natural selection is an element in that evolution of living forms of which the evidence appears to be irresistible. Natural selection is a *vera causa*; the question is, What is the extent of its action? how much can it do?

Darwin considered it necessary to supplement *natural* by that which he termed *sexual* selection; in doing which he was quite consistent, because he speaks (as we have already seen) of natural selection as "the most important, but not the exclusive, means of modification" of species. This supplemental hypothesis, however, does not commend itself to Mr. Wallace's judgment.

> Mr. Darwin (he writes), as is well known, imputed most of the colors and varied paterns of butterflies' wings to sexual selection—that is, to a constant preference, by female butterflies, for the more brilliant males; the colors thus produced being sometimes transmitted to the males alone, sometimes to both sexes. *This view has always seemed to me unsupported by evidence, while it is also quite inadequate to account for the facts.*

Again, after explaining his own views on the subject of ornamental appendages of birds and other animals, he writes:

> The various facts and arguments now briefly set forth afford an explanation

of the phenomena of male ornament as being due to the general laws of growth and development, and make it *unnecessary to call to our aid so hypothetical a cause as the cumulative action of female preference.*

Whether the views put forward by Mr. Wallace do in reality render unnecessary the Darwinian hypothesis of sexual selection will not be here discussed; it is sufficient to note that the conclusions of Mr. Darwin in this not unimportant matter have, after abundant time for examination and reflection, been rejected by the naturalist who more perhaps than any other has a right to criticise him.

But Mr. Wallace rejects also the evolutionist views of another very competent naturalist, Prof. Romanes; and it will aid in the development of the purpose of this paper if I refer in passing to this rejection. The theory of Prof. Romanes is described by him under the phrase *physiological selection;* it is not necessary in this place to explain what the theory is; it is sufficient to say it is regarded as highly important by Prof. Romanes, and as utterly unfounded by Mr. Wallace. It would be impertinent on my part to offer any opinion as between these two authorities; but the conclusion may be fairly drawn that there is probably much at present unknown in the subject of evolution, as well as not a little doubt with regard to some fields of inquiry into which our knowledge is supposed to extend.

But the most striking and interesting feature of Mr. Wallace's book, from what I may describe as the *human* point of view, is to be found in that part of his work in which he denies, and (as he believes) proves himself to be justified in denying, the application of the principle of natural selection to the evolution of the human faculties. This denial is a fact of the first order of magnitude; and I confess that I can see no ground for the language of strong depreciation in which Prof. Romanes, in the article already referred to, describes this portion of Mr. Wallace's book. He speaks of the substance of the concluding chapters as being "sadly like the feet of clay in a figure of iron, marring by its manifest weakness what would otherwise have been a completed and self-consistent monument of strength." No argument in the article justifies this condemnation; and it is, perhaps, not too much to say that many of his readers will find in the condemned portion of Mr. Wallace's book that which has the deepest interest for themselves, while it must not be forgotten that the views put forward are alleged by Mr. Wallace to rest upon proofs which he formally submits for examination. Let us see, then, what this clay formation contains.

Mr. Wallace fully accepts "Mr. Darwin's conclusion as to the essential identity of man's bodily structure with that of the higher mammalia, and his descent from some ancestral form common to

men and to the anthropoid apes." But he observes that "although perhaps nowhere distinctly formulated, his (Mr. Darwin's) whole argument tends to the conclusion that man's entire nature and all his faculties, whether moral, intellectual, or spiritual, have been derived from their rudiments in the lower animals, in the same manner and by the action of the same general laws as his physical structure has been derived." This conclusion Mr. Wallace considers to be "not supported by adequate evidence, and to be directly opposed to many well-ascertained facts."

I will not endeavor to reproduce the whole of Mr. Wallace's argument on this subject, but will present what appears to me to be the pith of it; and I do this with the greater satisfaction, because what is here advanced seems to harmonize with what I have already written in criticising the phrase *survival of the fittest.*

Let us confine ourselves, for simplicity's sake, to one human faculty, namely, the mathematical. The problem is, how to produce a mathematician by the process of natural selection. The reader must bear in mind clearly what the theory of natural selection is, as already expounded. It is the survival in the struggle for life of those individuals which possess variations from their fellows favorable to their preservation. In order, therefore, that the mathematical faculty should be evolved by the process of natural selection, it is necessary to suppose that those individuals, which have an advantage in the possession of rudimentary mathematical faculties somewhat in excess of their fellows, should be the survivors in the struggle for life. The mere possession of this rudimentary advantage must be an aid toward life preservation. This in itself is hard to understand; but it becomes harder still when we bear in mind the rareness of the mathematical gift. In our own time it would be perhaps an overestimate to say that the mathematical faculty existed in any marked degree in one per cent of the population; assume such a proportion to have generally held in human history, then it would be necessary to suppose that these rare specimens of rudimentary mathematical ability had some very decided advantage in the struggle for life: but what ground is there for such a supposition? Grant that ten men in a tribe of a thousand had discovered how to count upon their fingers, or suppose them to have discovered some elementary geometrical theorem, how would this help them when a neighboring tribe attacked them, or when famine and pestilence were abundant? It is difficult or impossible to say.

And the same argument would seem to apply to other human faculties, music and all forms of art, writing, even speech. Consider speech for a moment as the most universal and most dis-

tinctive of human faculties. Here the problem is just the reverse of that which occurred in the case of mathematics: in that the favorable variation to be preserved is rare, in this the variation scarcely exists; the faculty of speech is universal; how, then, can there be a survival of the fittest where all are equally fit?

It seems difficult to resist this kind of argument, and I should not be surprised to find the opinion gain ground, and ultimately become established, that while the human faculties have undoubtedly been developed gradually, the development can not in any way be traced to the process of natural selection.

But if it be once admitted that the principle of natural selection is inadequate to explain the development of specially human qualities, there is a temptation to go back to the consideration of the powers and instincts of some of the inferior creatures, and to inquire whether natural selection may not be inadequate also in their case, as in that of man. I confess that I have never been able to perceive how the principle can be brought to bear upon such phenomena as the architecture of insects—for example, that of bees and wasps. What, I suppose, ought to have happened is this, that some variation of an ancient form of bee made a rough approximation to a modern honeycomb, that they who made the best honeycomb were the fittest to survive, and that in this way by slow degrees and by natural selection a race of bees was produced capable of performing the geometrical wonders which modern bees perform. But there are two difficulties: First, in conceiving the original start of insects in the direction of architecture; and, secondly, in perceiving the connection between good architects and survival in the struggle for life. Certain bees might make their wax go further than other bees, and our actual bees use their wax with absolutely mathematical economy; but it is difficult to perceive how this economy is helpful in the struggle for life. Can we get over these difficulties? If it were a case of some device for self-preservation, the conclusion might be different. For example, if we can imagine some variation of a race of spiders devising, in ever so rough a form, those curious houses which have attained such perfection in the hands of the trap-door spider, we can also easily believe that this variation would be likely to survive, and that while less ingenious spiders became the prey of their enemies, those which were concealed in their cunning castles would escape. But there is nothing parallel to this in the case of wasps and bees; here we have a beautiful geometrical problem somehow solved, apparently without connection between the solution and the preservation of life. One of two conclusions seem inevitable—either the geometrical skill has belonged in its perfection to bees and wasps ever since those insects existed; or else the geometrical skill has been developed by some

internal law of growth, independently of all questions of natural selection.

There is another class of natural phenomena upon which Mr. Wallace writes much that is deeply interesting, but to which it may possibly be questioned whether the principle of survival by natural selection is applicable—namely, the phenomena of mimicry. Of course it is quite intelligible, to take an instance, that a living creature which is very much like a leaf will escape many enemies, and even have such an advantage in the struggle for life that many other living creatures would be like leaves if they could. But when we endeavor to go back in imagination to the commencement of the mimicking process, we must conceive of a creature not at all like a leaf, but among whose offspring there are certain individuals which have a slightly leaf-like appearance, and that these survive in preference to others not having the appearance in question. The conception involves two difficulties: First, the notion of certain individuals having a slightly leaf-like appearance is eccentric and hard to accept. It is different from that of individuals varying by length of leg, or strength of wing, or what not. It is a variation, so to speak, not of degree but of kind. And, secondly, it is difficult to see why a resemblance to a leaf, admitted to be slight, and therefore one would imagine not easily perceived, should be any substantial protection from enemies, and so an appreciable advantage in the struggle for life.

Similar difficulties occur with regard to other cases of mimicry. My space does not permit me to examine them in detail; but I have come to the conclusion that, while mimicry may probably be always connected with some advantage which it confers on the animal, it is difficult to conceive of the mimicking transformation being originally brought into operation by any process of natural selection.

This failure of the principle of natural selection to explain much that is connected with the evolution both of men and of inferior creatures may lead us to inquire, to what extent the principle satisfies etiological requirements even in those cases in which its application appears most complete. The modification and multiplication of species require three conditions to be postulated: (1) an original species; (2) the power of multiplying that species by reproduction; and (3) the occurrence of variations in the successive generations.

Now (1) the existence of the original living germ or germs must, I suppose, be left by universal consent in mystery. Mr. Darwin treated of the Origin of "Species," not the Origin of "*living things.*" This latter question is not likely ever to come within the reach of human science; certainly it has not done so yet. Given the existence of the material universe, or the existence of

living things, and there is abundance of opening for discovery with respect to the laws of matter and the laws of life; but matter and life must first be given: this is sufficiently obvious; but it is worth noting, because there is sometimes a tendency to make a confusion between creation and the laws of created things; whereas it is obvious that creation is one thing, and the law governing created things is quite another. But (2) as the original existence of living things is a mystery, so also is the reproduction of them. The continuity of life on the earth's surface, insured in various ways more or less resembling each other, and all agreeing in this, that there is apparently no tendency in vital power to degenerate or wear itself out in the course of ages, is, as it were, a standing mystery of creation. The scientific man has nothing to do with this mystery; to him it is simply a fact or phenomenon; but he who tries to go beyond phenomena and to get at the cause behind them will recognize reproduction as being etiologically equivalent to continuous creation. The great feature, however, of the principle of natural selection is (3) the occurrence of variations. Mr. Wallace lays great stress on the abundance of the variations which occur in nature, and the corresponding importance of this element in the Darwinian theory; and he is obviously wise in doing so. But it is well to observe that it is impossible to regard variations either on the one hand as a necessary feature of reproduction, or on the other as simply fortuitous. With regard to the latter supposition it is, certainly, difficult to conceive of chance as being a principal factor, say, in the production of a horse, to say nothing of a man. But even the former supposition is not quite an easy one: it is difficult to see why variations capable of being made permanent should occur, and why (if there be offspring at all) the offspring should not be exactly like the parent; in not a few cases this seems to be the law of living things. What I wish to point out, however, is this, that from the etiological point of view there ought to be a *cause* for variations as well as for other phenomena; and that, therefore, when we use the phenomenon of variations as a part of the machinery of natural selection, we do not get rid of the task of inquiring, as philosophers, why those useful variations occurred. In fact, in this as in many other instances, what is done is to shift the process one stage backward, but to leave the question of the primary cause very much where it was. Variations are abundant, says the student of natural history, and advantageous variations are preserved and made permanent by the process of natural selection: let it be granted. But the philosopher may still say: How comes it that advantageous variations should occur? Must not this occurrence be the result of some pre-established principle or law of development?

Take the case of the horse, which Mr. Wallace has dwelt upon

at some length, and has illustrated by a diagram. The evolution of the horse of historical times and of the present day from the *orohippus* of the Eocene period, as exhibited to the eye by Mr. Wallace's diagram, is as interesting a presentation of a physical pedigree as can well be conceived. We see, as it were, the progress of Nature's work; the transformation from several toes to one toe, which was, in reality, the operation of thousands of years, is visible as a connected continuous process from beginning to end. But what the diagram does not, and can not, put in evidence is this—namely, the marvelous beauty of the horse in his ultimate condition. So far as any conclusions can be drawn from the diagram, the top and the bottom of the page stand upon an equal footing; there would seem to be no reason why *orohippus* should not have been derived from *equus* by expansion, as easily as *equus* has been derived from *orohippus* by contraction. When, however, we look, not at the *equus* of science, but at the *horse* of the hunting-field or the race-course, or at our own stable friend, who has carried us safely for hundreds of miles, we perceive that, somehow or other, we have, in these modern days, an animal of the most perfect kind with regard to speed, beauty, and mechanical perfection. We feel convinced that it would be in every way a mistake that he should develop toes and become *orohippus;* we are sure that *orohippus* has rightly been improved off the face of the earth in order to make room for *equus*. All this is, in the best sense of the phrase, in accordance with the principle of the survival of the fittest; but I confess that I find it difficult to realize the transformation of *orohippus* into *equus* upon the pure and simple notion of advantageous variations in the struggle for life; for, in truth, if the question be one of mere survival, it is difficult to say, when the earth was inhabited by wild creatures, in what manner the possession of one toe instead of three or four should give *equus* any advantage over *orohippus*. One can quite understand that a jury of Newmarket jockeys would decide that *equus* was fittest to survive; but in the absence of human judgment the conclusion is not so easy to reach. At all events, it seems more probable that the transformation was originally ideally contained in the conception of this class of creature, and that *equus* may be regarded as bearing to *orohippus* something of the same kind of relation as is borne by a frog to a tadpole, or by a moth to a caterpillar.

May it not well be that predetermined transformation has as real a place in the genesis of species as it certainly has in that of individual creatures? Nothing, perhaps, strikes most minds as more surprising than insect and reptile transformation. That a crawling animal should, by a complicated process, involving a condition of motionless helplessness, be ultimately transformed into a creature of active life spent in flying through the air, or

that toads and frogs should find it necessary to pass through the fish-like life of tadpoles—this class of facts may well puzzle the thinking mind; but the advantage of them is that they *are* facts; no one can dispute them; and taking our stand upon them we may guess that the processes of Nature are analogous, in cases in which we can not distinctly prove that they are so. May it not be, then, that the Eocene period of creation presented a condition of things out of which a higher condition was evolved, not simply by the perpetuation of advantageous variations, but much more by virtue of an internal principle of growth, similar to, or at least comparable with, the principle which develops the fœtus or which transforms tadpoles and caterpillars? Adopting this view, we should have in both cases a limit toward which transformations tended; as the butterfly is the ultimate form of the caterpillar, and the caterpillar was the forerunner and necessary ancestor of the butterfly, so *equus* may perhaps be regarded as the ultimate form of *orohippus*, and *orohippus* as the forerunner and necessary ancestor of *equus*. At all events, this view of the facts seems to be tenable, and it is free from certain difficulties by which the hypothesis of natural selection pure and simple is undoubtedly beset.

The question of growth, evolution, development, by an internal power similar to, and comparable with, that which we see daily and hourly at work all round about us, leads to the discussion of another and very interesting question—namely, whether man can perfectly be described as "derived from the lower animals." The expression is Mr. Wallace's. He speaks of "man in his bodily structure" as having been "derived from the lower animals, of which he is the culminating development."* I venture to question whether this is a correct statement of the facts of the case. I am not venturing to throw doubt upon Mr. Wallace's scientific deductions; on the other hand, their correctness shall for the sake of argument, if on no other ground, be fully granted; all the more readily in consideration of the important limitations of the principle of natural selection made in the case of man, as already noticed and discussed. What I venture to doubt is, whether the process of human evolution, as accepted by Mr. Wallace, can be rightly described by the terms which he applies to it. Certainly there is something in the conception of such derivation from which the feelings of most of us not unnaturally shrink, and from which they would gladly be free, if freedom can be had consistently with scientific truth. There is something in it of that "letting the house of a brute to the soul of a man," of which Lord Tennyson sings in his most recent volume. It may be worth

* Page 454.

while, therefore, to consider whether the phrase, "derivation from the lower animals," is one which can be maintained as rightly expressing the truth which it is intended to express concerning the physical history of our race.

Now it is manifest that if we look back, so far as is possible, into the remote past, when the first germ of animal life appeared upon the globe, two conditions of things, and two only, are conceivable. Either (A) there was a single germ of life, from which all subsequent living forms have been evolved or developed; or (B) there were several or many germs of life, from which, in separate streams, so to speak, the evolution of living creatures took place. Mr. Darwin inclined, I think, to the latter supposition; but either A or B must be accepted by all evolutionists of all schools. Let us consider them successively.

A. If we make the supposition that living forms commenced upon the globe from a single germ, then it follows that all living creatures now existing—insects, fishes, birds, beasts, man—have been evolved by some process or processes from one and the same origin: whether the process of variation and natural selection be sufficient to account for the development, it is not necessary for the purpose of this argument to decide; it is sufficient to say, and this can scarcely be denied, that by some process or processes the development has taken place. Therefore, ascending to the hypothesis now under consideration, it will be true that the lower animals and man had a common origin; but this is manifestly a different thing from asserting that man is "derived from the lower animals." If we go up to the hypothetical origin of life, or the single germ, this latter assertion is obviously untrue, because, as by hypothesis there was then only one germ, there could be no distinction of superior or inferior; but if we stop short of the origin and observe the condition of things at any period subsequent to the hypothetical beginning, we shall find progress being made toward the development of man and simultaneous progress being made toward the development of the lower animals. But it does not follow that, because this simultaneous development is taking place, therefore we can say that one form of life is developed from the other; it might be as correct to say that the inferior animals were developed from man, as man from the inferior animals. Take an illustration from that which is possible in the case of rivers. Conceive of two rivers running into the sea; trace their course, and suppose that ultimately you come to the same source in the distant mountains; it would not be correct to say that one of these rivers was derived from the other. The correct statement would be that they sprang from one and the same source, that they had different histories, and that they terminated in different streams.

When we speak of the lower animals, do we not in fact postulate the existence of man? Lower than what? Surely lower than man: therefore inferiority can not be predicated until man's existence has been assumed, or has become a fact; and therefore to speak of man being derived from the lower animals in the remote past, when, if you only go far enough, there is no higher or lower, would seem to be a confusing use of language.

If it be urged that the objection now made to the phraseology used by Mr. Wallace is merely a verbal quibble, I venture to argue, on the other hand, that there is not a little importance in the objection. I quite admit that if the creation of man be a merely fortuitous fact, a lucky hit, so to speak, in the infinite variety of living forms developed from a single original living germ—if, in fact, creation be without the high purpose which human life, as distinguished from all other forms of life, seems to make manifest—it is scarcely worth while to argue the question whether man was derived from the inferior animals or not. But if man be the intended crown of creation existing in the determinate counsel and foreknowledge of God from the beginning, then it does seem to be worth while to argue that the derivation of man and beast from the same living germ is not the same thing as the derivation of one from the other. A sane man may have the misfortune to have an idiot brother; the sane man and the idiot are derived from the same parents, but it would be incorrect to say that one was derived from the other. May there not be some analogy between a case of this kind and the case of man and beast?

B. So much, then, for the hypothesis of one original germ of life; the argument becomes perhaps more simple if we adopt the second hypothesis, namely, that of several or many germs.

For in this case it is not unreasonable to suppose that specific differences existed among the original germs. I confess that the notion of the development of all forms of life from one original germ offers to my own mind an almost insuperable difficulty. The arguments drawn from the experimental facts of variation and natural selection, from the observed progression of animal forms in successive geological strata, and the like, seem to me quite inadequate to explain the development of insects, fishes, birds, mammals, from one stock. Consequently, to my own mind it is a relief to be able to think of several, and if of several then possibly of any number, of original germs. The hypothesis is not opposed to, but quite in accordance with, Mr. Darwin's own views; in fact, he was far too cautious a man to dogmatize concerning the unity of the origin of living forms, when all attempt at the examination of the question of origin would necessarily carry him far beyond the limits of possible experiment. Let us

then adopt provisionally the hypothesis of a multiplicity of germs of life; and if we do this, there is nothing wild or strange in the supposition that the germ of man was different from other germs. It would be beyond all that scientific caution would justify to assume that, given a number of original germs of life, it is matter of chance into what each will develop. It is contrary, I think, to the whole analogy of Nature to suppose that a living germ, which is to all intents and purposes an ovum or egg, may ultimately develop into an oak, or a fish, or a man, according to its surroundings or according to mere chance. At all events, it is much more probable, much more according to analogy, that each germ should have its specific character, and that so man should have been man in intention and preparation from the very beginning of things. It may have been—in fact, according to the supposition of evolution it must have been—that in the early condition of life upon the globe there was no man (in the full and proper sense of the word) in existence, but his progenitors would be there; and what is submitted is this, that those progenitors were undeveloped men, and not "lower animals." What they visibly were scientific discovery has not yet put in evidence; it is admitted that there is a "missing link" between the present and the past. Some scientific men hope that the link may be found, some think that it is hidden under the sea; but, whatever the truth may be with regard to this point, what is maintained is this, that, on the hypothesis of a multiplicity of original germs of life, it is more probable than otherwise that certain germs contained the promise of men, others of "lower animals"; and that, if so, it is incorrect to speak of the lower animals as the progenitors of men.

This view of the case, though founded upon a criticism of Mr. Wallace's language, would seem nevertheless to be consistent with his real views concerning the origin of man. In the last chapter of his work, entitled Darwinism applied to Man, to which reference has been already made, it is contended, as we have seen, that the principle of natural selection will not account for the development of the human faculties. I recur to that chapter chiefly for the purpose of making two extracts, which will, I think, tend to strengthen the arguments which have been already advanced. After rehearsing three stages of progress in creation—the change from the inorganic to the organic; the introduction of sensation or consciousness, constituting the fundamental distinction between the animal and vegetable kingdoms; and the existence in man of a number of his most characteristic and noblest faculties, those which raise him above the brutes and open up possibilities of almost indefinite advancement—Mr. Wallace writes thus:

These three distinct stages of progress from the inorganic world of matter and motion up to man, point clearly to an unseen universe—to a world of spirit, to which the world of matter is altogether subordinate.*

And again:

Those who admit my interpretation of the evidence now adduced—strictly scientific evidence in its appeal to facts which are clearly what ought *not* to be on the materialistic theory—will be able to accept the spiritual nature of man, as not in any way inconsistent with the theory of evolution, but as dependent upon those fundamental laws and causes which furnish the very materials for evolution to work with.†

Declarations such as these, coming from such an authority, must doubtless be very comforting to those minds which feel themselves compelled to receive the evidence for evolution but shrink from materialism, which feel convinced that materialism can not be true, and yet have an uneasy suspicion that evolution points to it as a logical conclusion. But if we admit with Mr. Wallace that variation and natural selection are not adequate to explain the evolution of man's higher qualities and faculties, we are not merely delivered from the acceptance of materialism, we are invited and even compelled (as has been urged in a former part of this paper) to review the whole question of the extent of the application of Mr. Darwin's great principle. He would be a rash man who, in the face of Mr. Darwin, Mr. Wallace, and the whole generation of naturalists who have followed in their steps, should deny that natural selection was a *vera causa* in creative work; but there is no rashness or audacity in maintaining what Mr. Darwin did not deny, and what Mr. Wallace emphatically affirms, namely, that there is needed for the explanation of phenomena something beyond, and essentially different from, the process of natural selection. All seems to point beyond matter into the region of mind, beyond mechanical sequence to purpose, beyond all *veræ causæ* to the *causa causarum*, beyond Nature to God.

I will close this paper by recording an incident which was communicated to me some years ago in the course of conversation by Dr. Thompson, the late Master of Trinity College, Cambridge.

Dr. Thompson was walking, in his college days, with two companions, one of whom was Alfred Tennyson; of the name of the other I am not sure. The path by which they went was one which all Cambridge men know, namely, that which leads from the backs of the colleges through the fields toward Coton. After passing the brook, which used to be crossed (and perhaps is now) by a rude wooden bridge, it was perceived that Tennyson had

* Page 476. † Ibid.

lagged behind. He had paused by the side of the brook, brought his eyes as near as he could to the surface of the water, and was examining with intense interest the subaqueous life which the little stream contained. After a time he rejoined his companions, and this was his utterance when he joined them: "What an imagination God has!" The words must have made a deep impression upon my informant's mind; otherwise he would not have retained them in memory, and would not have thought it worth while to repeat them to me. They made a similar impression upon myself when so repeated; and I can not but regard them as containing a true philosophy of Nature. Whatever may be the power of natural selection, and whatever causes may be at work to produce the varied scene of life which the world contains, you need some underlying cause, both of life itself and of reproduction and variation, and of all natural phenomena; and if causally the existence of the universe may be attributed to God's will and purpose, so the endless variety of vital manifestations may be attributed to that which in the case of man we should call imagination.

In reality, whatever may be the actual historical genesis of Nature, we seem to need a *quasi*-Platonic doctrine of antecedent ideas in the divine mind as the basis, the underlying condition, of the existence of things as we see them. It is matter for fair discussion among naturalists how much may be attributed to natural selection, how much to sexual, how much to physiological, and so forth. But such discussions can not go to the root of things; they do not reach the original thought out of which the works of Nature, as we call them, originally spring. Michael Angelo, as we are told, used to sit with his hammer and chisel before his marble block, and shape it without any previous modeling process into the figure which he intended to produce; other sculptors, I believe, with only this one grand exception, make their model in clay, and thence proceed by semi-mechanical steps to the finished work; but Michael Angelo and all other sculptors have alike the seminal idea in their minds, and the manner of its evolution is comparatively a matter of detail. Something of the same kind may be said of the production of natural things. It may be possible for naturalists to discover some of the steps by which the finished work comes to be what it is; but the actual origin of natural things—the wonders of life, the varied beauties of the universe, above all, the mind of man, which is capable of understanding, appreciating, and discussing the problems to which natural things give rise—is to be sought in no region lower than that which may, with all reverence, be described as the mind, or as the imagination of God.—*Nineteenth Century.*

CATS AND THEIR FRIENDSHIPS.

By W. H. LARRABEE.

I HAD for ten years a cat whose intelligence interested me greatly and was considered remarkable by all persons who took notice of her. Her confidence in her master and mistress, her evident enjoyment of their society, her happy faculty of putting herself upon an understanding with them, her familiar interest in matters of the household, the shifts and devices of which she was master, and her sagacity manifested in ways as various as the exigencies she had to meet, evoked frequent admiration and praise. These manifestations led me to look into the subject of knowledge in cats, and I have found that she was not singular, or even exceptional, in the quality of her faculties. She appears to have been a type to which a great many of the more happily trained members of her race can easily measure up. My observations have been naturally extended to other animals, and have led to the conclusion that most domesticated species and many wild ones are capable of and often manifest equally high degrees of mental development. But cats—and dogs too—are more at home with us, have more opportunities to learn, and come under closer and more constant observation than the others.

The cat belongs to a large and highly specialized family; to one that is clearly distinguishable from the other families of animals, while the resemblances between its own members is so strong that even the careless, unprofessional observer will hardly fail to assign at a glance an individual of any of its species to it. All the members of the family are, according to Wood, light, stealthy, and silent of foot, quick of ear and eye. They are exceedingly graceful in form and movement, have flexible bodies and limbs—walk, we might say, on tiptoe—are alert and swift in action, and are exceedingly cunning. Between many of them and the cat itself there is hardly any prominently visible difference except in size. Curious resemblances in features of line or expression may be remarked between the portraits of the *Felidæ* in Wood's Natural History and cats with which the observer is acquainted. A copy of the photograph of the head and breast of a tiger at rest, in a portfolio by our side, might be easily mistaken, except for a few differences in the shading of the hair, for a life-size portrait of the cat that has given the occasion of this article. St. George Mivart recognizes fifty living species of the cat family, forty-eight of which he includes in the genus *Felis*.

The history of the domestic cat has been traced back to the ancient Egyptians, among whom the earliest notices of it appear

on the monuments of the second empire of the twelfth dynasty (about 2400 B. C.), at Beni Hassan. It seems to have appeared there just after the Egyptians had made considerable conquests in Nubia, whence it may have been brought, already domesticated, among the spoils of war. The mummified cats in the Egyptian tombs are not identical with our house cat, but seem to belong to a native species (*Felis maniculata*, Fig. 1) which is said to be still indigenous in Nubia, where it is found on the western side of the Nile, in a stony district in which brushwood grows.

FIG. 1.—EGYPTIAN CAT (*Felis maniculata.*)

The domesticated animal was slow in making its way from Egypt into the neighboring nations. The Hebrews were apparently without it, and it is not once mentioned in the Bible. No evidence has been found that the Assyrians and Babylonians were acquainted with it. According to authors who have investigated the philological branch of the history, these people possessed a binary nomenclature for animals, with generic and specific names, and included their lions and panthers among the dogs—a thing they would hardly have done if they had been familiar with house cats. It was not known to the Greeks and Romans till a comparatively late period; and all the earlier representations of cats on their monuments are referred by the authorities to the wild cat or some other animal than the domestic cat. According to the most careful conclusions on this subject, the mouser of the Greeks and Romans was a weasel, and led an independent, not a domestic, life. The Aryans of India had cats at a very early but not at their earliest period; for while the names of the animal are all Aryan, it was not, according to Pictet, designated by any simple term such as would have been given it in primitive times, but by composite names, having such meanings as "house-animal," "rat-eater," and "mouse-enemy." The name of the wild cat (Fig. 2), however, embodied a root common to many of the European languages. It becomes in Persian, *pushak;* in Afghan, *pishik;* in Kurdish, *psiq;* in Lithuanian, *pnijĕ;* in Irish, *pus* and *feisag;* and in Erse, *pusag* and *piseag;* whence the English "puss." It is derived by Pictet from a Sanskrit root *puchha* or *pitchha*, that means "tail," and therefore points to one of the most striking external features of the animal. The name by which the cat was known to the later Greeks—αἴλουρος—and which was originally applied to the weasel, refers to the same feature. It is

compounded from two words that give the meaning of "wavy tail."

The Latin name of the cat tribe (*Felis*) appears to have been originally applied to the weasel and other mousers, and afterward to the wild cat. The word *catus* or *cattus* came into use in about the fourth century, and is found first in the agricultural writer, Palladius, who recommends that cats be kept in artichoke-gardens for protection against mice and moles, and remarks that men had previously been served for this purpose by weasels. The name *catta* is found later in the Greek church historian, Evagrius Scholasticus, about A. D. 594. Historical inferences have been drawn from the absence of the remains of cats in the ruins of Pompeii, and from the fact that the name common to all the other Romance languages does not occur in Wallachian. It is concluded that the domesticated animal had not become common when Pompeii was destroyed, in A. D. 79, or when Dacia was isolated from the rest of the Roman world by barbarian conquest, in the third century. Mr. W. Boyd Dawkins infers, from his researches in the caves in which the Celts took refuge from the Saxons, that cats were unknown in Great Britain before about the year 800.

FIG. 2.—WILD CAT (*Felis catus.*)

Cats easily commended themselves as efficient vermin-destroyers to such extensive grain-raisers as the ancient Egyptians; and a people so ready to deify everything needed little prompting to put them in their pantheon. They may also have made themselves useful in killing snakes, an occupation in which, if the stories are true, they sometimes become very expert. Rengger, who has written of the mammals of Paraguay, declares that he has more than once seen cats pursue and kill snakes, even rattlesnakes, on the sandy, grassless plains of that land. "With their rare skill," he says, "they would strike the snake with their paw, and at the same time avoid its spring. If the snake coiled itself, they would not attack it directly, but would go round it till it became tired of turning its head after them; then they would strike it another blow, and instantly turn aside. If the snake started to run away, they would seize its tail, as if to play with it. By virtue of these continued attacks they usually destroyed their enemy in less than an hour, but would never eat its flesh."

Cats are represented on some of the Egyptian monuments as accompanying their masters on hunting expeditions. In a wall-

picture on a tomb at Gurneh, a hunter is represented in his boat in the marshes as about to hurl his throw-stick at a covey of birds, while a cat by his side is on the alert to spring upon the game he is expected to bring down. Another picture (Fig. 3) represents the cat seizing a bird. This would involve going into the

FIG. 3.—AN EGYPTIAN FOWLING SCENE. 1. Sportsman using the throw-stick. 2. Keeps the boat steady by holding the stalks of a lotus. 4. A cat seizing the game in the thicket. 5. A decoy bird. 6. Fishes, the emblem of water.

water, an act to which our modern cats usually have a very strong dislike. If the Egyptian cats had the same feelings, they must have come under the discipline of skillful trainers. But there have been fisher cats in modern times. Mr. Ross, in his Book of Cats, tells of one that lived in 1829, which caught fish with great assiduity, and frequently brought them home alive. She taught another cat to fish, and they used to go out together, sometimes taking opposite sides of the river. Another story is quoted by the same author, of a cat at the battery in Plymouth, England, that was in the habit of diving into the sea, bringing up fish, and leaving them in the guard-room for the sailors. She was seven years old, and "as fond of the water as a Newfoundland dog," and hunted regularly along the rocks at the water's edge for her game, "ready to dive for it at a moment's notice." A cat described by Mr. Lawson Tait was a remarkable fisher, and would

FIG. 4.—CATS' TAILS.

wade into a small pond up to her shoulders to catch her game. She was "always fond of dabbling in the water." Mr. Harrison Weir* tells of a cat which used to go into the water up to her shoulders to bring in the fish which her master drew up with the hook, and which stole out the minnows that had been placed, for safe keeping, in a well of cold spring-water.

The domestic cat is not identical with the Egyptian cat, and, therefore, if descended from it, must have undergone modifications in the process. It is not known whether it has interbred with the wild cat; but it is possible that some of the varieties have originated in that way. The marks of difference between the species are very plain. The most obvious one is the shape of the tail (Fig. 2), which in the domestic cat is long, slender, and tapering, while in the wild cat it is shorter, stumpy, and bushy. The fact that no tendency has been observed in either of these

FIG. 5.—MRS. SCOTT'S ENGLISH TABBY "COPPA." First Prize at the Crystal Palace Cat Show, 1886.

forms of tail to revert to the other is in favor of a permanent specific difference. The minor varieties of cats are numerous, but the important ones are not many. A line is drawn between the short-haired and the long-haired varieties. Of the former are the tabbies (Figs. 5 and 10)—brown, blue, or silver; red and spotted tabbies—of various colors, with their delicate stripings, cloudings, or spots; the Chartreuse, blue, or Maltese, which has long, slate-colored fur, and a bushy neck and tail; the Spanish, or tortoise-shell (Fig. 11)—white, black, and reddish-brown, mixed, whose

* Our Cats and all about Them. Boston and New York: Houghton, Mifflin & Co.

closer resemblance than that of the others to the Egyptian cat has suggested that the animal may have come to Europe by way of the Strait of Gibraltar; and the Manx (Fig. 6), a curious variety, says Wood, on account of the entire absence of a tail, the place of which member is only indicated by a rather wide protuberance. "It is by no means a canny animal, for it has an unpleasant, weird-like aspect about it. . . . A Manx cat, with its glowing eyes and its stump of a tail, is a most unearthly-looking beast." The manner in which its peculiarity has been perpetuated has not been accounted for. The long-haired cats include the Persian (Fig. 7), a gray-blue and silky animal, having a tail of great length and covered with hair six inches long, which it carries arched over its back like a squirrel's; and the Angola, a beautiful animal, and knowing it—"gorgeous in its superb clothing of long, silky hair and bushy tail." It is one of the largest of domestic cats, and one of the heartiest eaters. Then there are the Chinese cat, large, with fine, glossy hair and hanging ears; the royal cat of Siam (Fig. 8), clear tawny or buff, with black muzzle, face, ears, and feet, suggesting the figure of a pug dog; black cats, which belong among the tabbies; and white cats, concerning which the belief prevails that if they also have blue eyes they are deaf. This connection has been accepted by Mr. Darwin as an instance of correlated variability, and is explained by Mr. Lawson Tait—the white color or albinism being regarded as a result of arrested development—by the fact of the common origin in the epiblast of the three structures affected—the fur, the iris, and the tympanic membrane.

FIG. 6.—MANX CAT.

The bent of the cat's mind was pleasantly defined a few years ago by a writer in the London Spectator, who said there could be no doubt as to the view Puss took of the philosophy of nature and life. She is quite satisfied that the world and everything in it were made and exist for cats. This appears in all that well-bred and cared-for cats do, and in every accent and tone of their voice. Puss possesses herself with the air of a proprietor of the best place and the best food; expects to be waited upon; demands a share of every dish; and looks upon us as at once her Providence and her servant.

Cats are not demonstrative like dogs, and do not submit to training like the horse. The dog has been credited with unbounded affections, and the horse with almost human sagacity;

but the cat still suffers under the bad character that Buffon—who can not have been acquainted with any reputable specimens of the race—gave her. She is said to be selfish, spiteful, cruel, crafty, treacherous, loving places and not persons, and in every way unworthy of fellowship in the household. J. G. Wood answers these accusations by saying that the cats with which he has been most familiar "have been as docile, tractable, and good-tempered as any dog could be, and displayed an amount of intellectual power which would be equaled by very few dogs, and surpassed by none." To all persons who have given their confidence to Puss and received hers in return, they need no answer.

FIG. 7.—MRS. VALANCE'S PERSIAN, "FLUFFY II." Crystal Palace Cat Show, 1886.

Numerous traits of the sort that make all the world kin appear in the cats—human-like qualities and affections that bring them into sympathy with their masters. Such traits will be made manifest to any one who even partially takes Puss into fellowship; and whoever puts himself on good terms with her will find his association marked by wonderful examples of intelligence and affection, and will be ready to declare that there is no cat like the particular one with which he is dealing. The declaration will be true in a measure, for individuality is one of the most conspicuous traits of the species. A considerable literature has been written in demonstration and illustration of the more pleasing aspects of feline character, on which I have drawn for incidents from works that will be mentioned in course; and more freely from articles on animal intelligence in Nature and the Revue Scientifique, and from a Cat Competition, organized several years ago by the Republican Journal, of Belfast, Maine, in which many contributors gave the stories of their pets. Evidences are afforded in these observations of the habitual exercise by cats, in the ordinary course of their lives, of such qualities as recognition of their friends and attachment to them, capacity to form friend-

ships with men and animals, exercise of self-denial, willingness to do favors or to help, understanding of language, ability to make their wants intelligibly known, humor, foresight, knowledge of right and wrong, the use of means to ends, capacity to adapt means to circumstances, the time-sense, and many other forms of intelligence. Lindsay, in his Mind in the Lower Animals, shows also that they, with other brutes, are liable to mental diseases not unlike those to which the human mind is subject.

Théophile Gautier, remarking on the difficulty of conquering the friendship of a cat, says that "she is a philosophical animal, orderly, quiet, tenacious in her habits, a lover of order and propriety, and one who does not bestow her affections blindly. She will gladly be your friend if you are worthy of it, but not your slave. In her tenderness she regards her own free will, and will not do for you what she judges to be unreasonable; but once she has given herself to you, what absolute confidence, what fidelity of affection!" Wood says that there is perhaps no animal so full of trust as a cat that is kindly treated, as there is none which, when subjected to harshness, is so nervously suspicious. Cats keenly recognize these distinctions in character, even among members of the same family, and govern themselves accordingly. Pertinent to this point is the newspaper squib of the maid who told her master that she knew Tom had returned from school, though she had not seen him, because the cat was hiding under the stove.

FIG. 8.—MRS. VYVYAN'S ROYAL CAT OF SIAM. Prize-winner. By permission, from Harrison Weir's Our Cats and all about Them. Published by Houghton, Mifflin & Co., Boston and New York.

"Tad," of Burnham, Maine, used to meet his master, a night watchman, every morning at the store-door, and accompany him home. After the master died, "Tad" continued to go for him and wait; then, not finding him, would return home and wander about the house as if in search of him. "Hannah," of North Monroe, Maine, began to take care of the baby as soon as it came; increased its attentions when the child could walk; would go after him and call him back when he started to wander out of bounds, and then go to the house and mew for help till some one came to take the truant in charge. "Thomas," of Sandy Point, Maine, was accustomed to be fed with crumbs from the table by a single

member of the family, and to go and call him to dinner if he was tardy. My cat in like manner used to look to her mistress and to no other person for tidbits from the breakfast-table. "Daisy," of Belfast, who stayed with her mistress during an illness, missed her from the room and went out to look for her. Meeting her unexpectedly, she looked up, says the mistress, "as frightened as if she had seen a ghost. My voice, however, reassured her, and, if ever a cat smiled, I am sure she did." Another cat of the Belfast group, not a favorite and shy toward all other persons, became attached to a sickly infant and its faithful nurse, never failing to respond to its cries by going to its cradle and soothing it by purring and caresses till it became quiet. The cat of M. Arbousset, a French missionary in Africa, refused food when the child to which it was attached died, sought and mourned for its friend in a marked manner, and in a few days was found dead on its grave. The suggestion has been made, and is worthy of con-

FIG. 9.—ARCHANGEL BLUE CAT. By permission, from Harrison Weir's Our Cats and all about Them. Published by Houghton, Mifflin & Co., Boston and New York.

sideration, that when pets die in this way soon after their human companions, it may be because they caught the disease from them rather than from intensity of affection. But this can not apply to the cat told of in the Leisure Hour, which, when the child its playmate died, refused food at first, but afterward, having found its companion's grave, spent most of its time there, going to the house for its meals. A critic, in the Saturday Review, claims to have known more than one instance of a cat, ordinarily constant to its own habits of comfort, breaking through its self-made rules to sit outside the door of an invalid as if waiting for news. The Rev. J. G. Wood's "Pret" was capable of the most earnest manifestations of gratitude. One day, when, having been forgotten, she had become very hungry, she flew "like a mad thing" at the meat and milk her master gave her; but hardly lapped a drop before she went to him purring loudly and caressing him to express her thanks; then went to the plate, "but only just touched

her nose, and again came to thank me"—actually refraining from enjoying the food she was so much in want of till she had repeatedly acknowledged her obligations for it.

A story is quoted by Mrs. Cashel Hoey from the London Spectator, of "Nero," who, loving all the family and showing his love for each in different ways, especially loved his master, and was usually the first to hear his step. He could distinguish the click of his master's door-key, and would run to answer it; was distressed if his master failed to return at evening, and would go look for his portmanteau, to see if that was gone too—that being his sign that master was taking a journey. If the portmanteau was in its place, he was satisfied; if not, he would lie down and refuse food. If he knew the master was going away, he would try to hide himself in the cab; and if master appeared with his hat on in the daytime, supposing he was going out, would try to take it off; but if at night, was contented, for master had come home.

FIG. 10.—FINELY MARKED SPOTTED TABBY CAT. By permission, from Harrison Weir's Our Cats and all about Them. Published by Houghton, Mifflin & Co., Boston and New York.

The cat's strong attachment to its home, and indisposition to change it, are not peculiar to it, but are common to all animals, including man. The trait is often manifested, and sometimes in remarkable ways, in dogs, horses, and cattle. In man it is frequently illustrated in the affection known as "homesickness." The ability which animals display under its influence in finding their way back to their old accustomed haunts from long distances and by difficult or tortuous ways, or even by roundabout roads, when return over the direct route (as when it includes the crossing of bodies of water) is impossible, is the wonder of naturalists, and up to this time one of the unsolved

problems of animal psychology. It has received the name of "the homing instinct," and is regarded by some naturalists as constituting an additional sense. The dog seems usually to be more ready than the cat to follow his master in a change of home, and to reconcile himself to the new place, but this may be because he stands in a different relation toward him. The dog is sure of at least one fast friend wherever he lives, while the cat can not always reckon even upon that. In many families, where she is tolerated, as, according to Buffon, only because she is less objectionable than the rats and mice, she has no one to caress her or show affection to her. In this case, when her situation is barely endurable, she naturally fixes her attachment on the place where she has found cozy retreats and knows all the hunting-grounds, rather than upon persons who have given her no consideration, and of whom she perhaps stands in fear. Whether the cat will in the long run prefer its old home, deserted or inhabited by strangers, to a new home, along with the persons it has been accustomed to meet, may depend very much upon the treatment it has received from those persons. My cat was removed three times in ten years; and, aside from the temporary embarrassment caused by finding herself in a strange place, readily adapted herself to the new quarters, and showed no disposition to go back to the old haunts. Lindsay, in

FIG. 11.—FINELY MARKED TORTOISE-SHELL CAT. By permission, from Harrison Weir's Our Cats and all about Them. Published by Houghton, Mifflin & Co., Boston and New York.

his Mind in the Lower Animals, refers to cases of cats following their masters from house to house, from place to place, and accompanying them on visits to other people's residences, as unconcernedly as a dog. Wood tells of a family on the coast of Scotland who removed to the opposite shore—sailing around instead of crossing the country—leaving their cat with a neighbor. But the animal followed them, and found them in some way, presenting itself after a few weeks at their door, "weary, ragged, and half starved." It had left its old home and gone out into the unknown to seek the family with whom it had lived. A case pre-

cisely similar, except as to the local topography, is related in Chambers's Journal, of a cat in a military chaplain's family at Madras. This animal also, having found its old friends on the other side of the city, several miles from their former home, went back and brought her kitten. Some of the incidents bearing upon this feature have an aspect of eccentricity. The young cat of a neighbor of the writer's disappeared from the house and was not found or heard of for six months. At the end of that time it returned and made itself at home at once, but grown and so changed that, though its familiarity was remarked upon as singular, it was not recognized till its identity was accidentally established by the discovery of a peculiar though obscure mark. Dr. A. Corriveau tells in the Revue Scientifique of a cat which was lost in a similar way. Five months afterward it was found in the house by the side of its companion, travel-soiled but plump, and recognizable by a red spot on its forehead. It had a very pleasant visit with its old mate and friends for a week, and then disappeared as unaccountably as it had done before. It is told in the Life of Sir David Brewster, by his daughter, that a cat in the house entered his room one day and made his friendship in the most affectionate manner—"looked straight at him, jumped on his knee, put a paw on each shoulder, and kissed him as distinctly as a cat could." From that time the philosopher himself provided her breakfast every morning from his own plate, till "one day she disappeared, to the unbounded sorrow of her master. Nothing was heard of her for nearly two years, when Pussy walked into the house, neither hungry nor thirsty nor foot-sore—made her way without hesitation to the study—jumped on my father's knee—placed a paw on each shoulder—and kissed him exactly as on the first day."

These incidents pertain to only one of the human-like traits that have been named as to be found in cats. The study to which they introduce us is an alluring one, and opens the more expansively the further we proceed in it.

PROF. MENDELEJEFF, in his Royal Institution lecture, found an analogy between the unseen world of chemical changes and the visible world of the heavenly bodies. Our atoms, he said, form distinct portions of an invisible world, as planets, satellites, and comets form distinct portions of the astronomer's universe; "our atoms may therefore be compared to the solar system, or to the systems of double or of single stars; for example, ammonia may be represented in the simplest manner by supposing the sun nitrogen, surrounded by its planets of hydrogen, and common salt may be looked upon as a double star formed of sodium and chlorine. Besides, now that the indestructibility of the elements has been acknowledged, chemical changes can not otherwise be explained than as changes of motion; and the production by chemical reactions of galvanic currents, of light, of heat, of pressure, or of steam-power, demonstrates visibly that the processes of chemical reaction are inevitably connected with enormous though unseen displacements, originating in the movements of atoms in molecules."

RECENT GLACIAL WORK IN EUROPE.

By Mrs. K. B. CLAYPOLE.

AT the recent meeting of the British Association at Newcastle, Prof. James Geikie opened the Section of Geology with a summary of the results obtained during the last few years by continental glacialists. Sketching the steps by which the iceberg theory has been abandoned by German and Swiss geologists, he dwelt on certain features of the drifts of the peripheral areas, which for some time were hard to account for by land-ice. Of these, the bedded deposits occurring so frequently in the bowlder-clays of the peripheral regions, and the occasional silty and uncompressed character of the clays themselves, remained unexplained until a clew was found to their origin in the geographical distribution of the clays in which they occur. These stony clays, of inconsiderable thickness in Norway, the higher parts of Sweden, and in Finland, reach a thickness of about forty-three metres in southern Sweden, and eighty metres in the northern parts of Prussia; and in Holstein attain a depth of one hundred and twenty to one hundred and forty metres, and still greater depths in Hanover, Mark Brandenburg, and Saxony. The aqueous deposits associated with the stony clays also gradually acquire more importance as they are followed from the mountainous and high-lying tracts to the low ground, until, along the southern margin of the drift area, the "diluvium" appears to consist of aqueous accumulations alone. The explanations of these facts by German geologists have been summed up recently (1884) by Dr. Jentzsch, from whom Prof. Geikie quoted enough to show that they are quite in accordance with the views long held by glacialists elsewhere.

The general conclusions reached by continental glacialists, and summarized by Prof. Geikie, are:

1. Before the invasion of northern Germany by the inland ice, the low grounds bordering on the Baltic were overflowed by a sea which contained a boreal and arctic fauna.

2. The next geological horizon in ascending order is that which is marked by the glacial and fluvio-glacial detritus of the great ice-sheet which flowed to the foot of the Harz Mountains, and has been traced by the occasional presence of rock-striæ and *roches-moutonnées*, of bowlder-clay and northern erratics, rather than by recognizable terminal moraines.

3. A well-marked temperate fauna and flora marks the interglacial beds which follow, and which, in their geographical distribution and the presence in them of such forms as *Elephas antiquus*, *Cervus elephas*, and *C. megaceros*, and a flora compar-

able to that now existing in northern Germany, justify geologists in concluding that this era was one of long duration, and characterized in Germany by climatic conditions apparently not less temperate than those that now obtain.

4. To this well-marked interglacial era succeeded a second overflow of Scandinavian inland ice, confined to a region much narrower than that covered by the first. Its boundaries are shown not only by the geographical distribution of the youngest bowlder-clay, but by the direction of rock-striæ, the trend of erratics, and the position of well-marked moraines.

Concerning the ground-moraines of the Alpine lands of central Europe, the only question that has recently given rise to much discussion is the origin of the materials themselves. The observations of able investigators appear to Prof. Geikie to have demonstrated that these materials have been derived, in chief measure, from the underlying rocks by the erosive action of the ice that overflowed them. German geologists are not agreed upon this much-debated question of glacier-erosion—a few still maintaining that glaciers have little or no eroding power. But where the evidences of erosion have been studied over a wide region, from which the ice has completely disappeared, rather than at the lower ends of existing glaciers, some of the strongest opponents of glacier-erosion have been compelled to go over to the other camp. As an example, Prof. Geikie quoted Dr. Blaas, who, through his observations on the glacial formations of the Inn Valley, has recanted his former views and become a formidable opponent of the very theory which he once upheld. To his books and to memoirs by Penck, Brückner, and Böhn, and especially to the chapter on glacier-erosion by the last-named author, Prof. Geikie refers those who may be anxious to know the last word on this question.

Observations by Drs. Brückner and Penck have led to the opinion that the loess is of interglacial age. Examining a wider range of evidence, Prof. Geikie has little doubt that the loess belongs to no particular horizon, though it must be considered strictly a Pleistocene accumulation. Concerning its mode of formation he discussed the various theories advanced, and gave it as his opinion—an opinion formed from what he has himself seen of the loess in various parts of Germany, from reading, and from conversation with those who have worked over loess-covered regions—that it is for the most part of aqueous origin, formed in the slack waters of the great rivers, and in the innumerable temporary lakes which occupied or partly occupied many of the valleys and depressions of the land. Probably some may have been derived from the denudation of bowlder-clay, some from "rain-wash," while much of the so-called Bergloess with its abundant

land-shells, and its generally unstratified character, owes its origin to rain, frost, and wind. Admitting that some of the loess of the lower grounds may have been reworked by the same agents, Prof. Geikie found no evidence in the facts adduced by German geologists of a "dry-as-dust" epoch having obtained in Europe during any stage of the Pleistocene period.

Within recent years the fossils of the loess have received close attention, and through them so much knowledge has been gained of the various modifications experienced by Pleistocene organisms that, taken with other evidence of interglacial conditions, there is little room to doubt that this period was characterized by great changes of climate. How often arctic, steppe, prairie, and forest faunas and floras have replaced each other is yet a matter of dispute. The occurrence of fossiliferous deposits intercalated among glacial accumulations throughout all the glaciated tracts of Europe show that however many advances and retreats of the ice there may have been, they were on a gigantic scale characterizing all the glaciated areas.

The bearing of the establishment of at least two eras of glaciation on the position of Palæolithic man was pointed out by Prof. Geikie. The mere occurrence of glacial deposits underneath implement-bearing beds no longer proves these latter to be post-glacial. The horizon of glacial accumulations underlying Palæolithic gravels must now be determined by ascertaining their relative position; and it is a remarkable fact that the bowlder-clays which occur beneath such old alluvia belong, without exception, to the earlier stages of the Glacial period. In 1871–'72 Prof. Geikie published a series of papers in the Geological Magazine, maintaining that the alluvial and cave deposits must be assigned to preglacial and interglacial times, and in chief to the latter. Evidence was adduced to show that during the last stage of the Glacial period man lived contemporaneously with a northern and Alpine fauna, in such regions as southern France; and that Palæolithic man and the southern mammalia never revisited northwestern Europe after extreme glacial conditions had disappeared. Prof. Geikie at the same time colored a map to show at once the areas covered by the glacial and fluvio-glacial deposits of the last Glacial era, and the districts in which the implement-bearing and ossiferous alluvia had been found; and this clearly brought out that the latter never occurred at the surface within the regions occupied by the former. Similar evidence has been recently obtained by continental geologists; and a map published by Dr. Penck in 1884, showing the areas covered by the earlier and later glacial deposits in northern Europe and the Alpine lands, and indicating at the same time the various localities where Palæolithic finds have occurred, does not give a single

locality within the regions covered by the accumulations of the last Glacial era. So greatly are students of the Pleistocene ossiferous beds influenced by what is known of the interglacial deposits and their organic remains, that many do not now hesitate to correlate with those beds the old ossiferous and implement-bearing alluvia which lie altogether outside of glaciated regions. In France, where the relation of Pleistocene alluvia has been especially canvassed, these alluvia have been also included among interglacial deposits. M. Boule also, in the Revue d'Anthropologie, 1889, correlates the Palæolithic cave and river deposits of France with those of other countries, and shows that they must be of interglacial age. He is satisfied that in France there is evidence of three glacial and two well-marked interglacial eras. The oldest of the Palæolithic stages of Mortillet culminated during the last interglacial era, while the more recent Palæolithic stages coincided with the last great development of glacier ice. The Palæolithic age, so far as Europe is concerned, came to a close during this last cold phase of the Glacial period.

Interesting as is the development of the climatic and geographical changes of which our Palæolithic predecessors were the witnesses, the clearing up of the history of Pleistocene times is not the only end that workers in this field have in view. Prof. Geikie, therefore, closed his address with a hope that the definite knowledge of the conditions of the Pleistocene period and of the causes which gave rise to them would lead to the better understanding of the climatic conditions of still earlier ages; the success with which other problems have been attacked by geologists forbidding him to doubt that ere long we shall have done much to dispel some of the mystery still enveloping the question of geological climates.

THE BOTANIC GARDENS AT KEW.

By FREDERIK A. FERNALD.

IT is now about two hundred years—the exact date is not known—since Lord Capel laid out the garden that has become a scientific institution of world-wide fame and influence. Switzer says, in his quaint Ichnographia Rustica, 1718, "The earliness with which this lord appeared in gardening merits a very great place in my history, and a better pen than mine to draw it." On the death of Lord Capel, in 1696, the estate of Kew House, including the garden, passed into the hands of his son-in-law, who added to its importance for a while by making it the headquarters of English astronomy. It was afterward leased by Frederick, Prince of Wales, son of George II. The garden was made a scientific es-

tablishment—what they called a "Physic Garden" in those days—by the widow of Frederick, the dowager Princess Augusta, under the advice of the Earl of Bute. She employed William Aiton to direct the scientific work, and Sir William Chambers to superintend the decorative gardening. "Science will ever be grateful to the one," says a writer in The Saturday Review,* "and Taste will never forgive the other while his constructions remain." In 1768 Sir John Hill published a catalogue of the plants at Kew. There were fifty ferns, about six hundred trees and shrubs, and several thousands of herbaceous plants. The list was not greatly lengthened twenty-one years after, when Aiton issued the Hortus Kewensis with the aid of Dr. Solander. But the collections made by Sir Joseph Banks in Captain Cook's famous voyage were deposited here; then those of Robert Brown and Allan Cunningham, who had accompanied Captains Flinders and King respectively to Australia; then the plants of Brazil and the Cape of Good Hope, gathered by Messrs. Bowie and Masson; those of Caley, and Ker, and Menzies, and a host of smaller collections. In 1810 William Aiton the younger published a new edition of his father's work, which contained nearly ten thousand descriptions. About 1789 the estate was bought by George III, who devoted much of his leisure to its improvement. But evil days followed the death of Sir Joseph Banks, in whom Kew had a friend at court. For all Aiton could do, the gardens sank into neglect, and in 1838 it was proposed to disestablish and disendow them. A protest was raised, and, after further consideration, the gardens were surrendered by the crown and became a national establishment in 1840. Sir W. J. Hooker was appointed director in the following year. Kew has been fortunate in having had few changes in directors. It was in charge of William Aiton from 1759 to 1793; of William Aiton, Jr., from 1793 to 1840; Sir W. J. Hooker was director from 1841 to 1866; his son, Sir Joseph D. Hooker, from 1866 to 1886; and to him has succeeded Mr. W. T. Thiselton Dyer.

Under the directorship of Sir W. J. Hooker the Royal Botanic Gardens rapidly advanced in importance. During his term of office a report of the Progress and Condition of the gardens was made annually. This was superseded in 1883 by a monthly Bulletin of Miscellaneous Information. The early reports of Sir William Hooker are interesting, besides their historic and scientific value, for the evidence they give of his sturdy, ceaseless battles with the Treasury. The director is pathetic, indignant, and argumentative by turns, and one way or another he contrived to

* The writer is indebted to an appreciative article in The Saturday Review (London), of October 5, 12, and 19, 1889, for the material of this sketch.

worry on till better times. In 1844 Sir William took the first important step of his administration by petitioning for a grant of the Royal Fruit House, which he offered to fill with his private collection of plant products. It was allowed in 1847, and thus the Museum of Economic Botany had its origin. This branch of the establishment now occupies three buildings. Every tree and plant which is known to serve a useful purpose is represented there, with illustrations of the manner of its employment, if possible. While the collection is very popular with the holiday visitor who comes only to be entertained, any one can understand its serious value to an ingenious and thoughtful mechanic or manufacturer. The Museum of Timber is largely used already. Cabinet-makers and furniture manufacturers quite recognize by this time what a store of hints for their craft is garnered here. The utility of the economic section, moreover, is by no means confined to the inhabitants of the British Isles. From every quarter of the globe samples of new products are sent for examination and report.

So long ago as 1815 an Herbarium and Botanical Library had been projected at Kew. George III, doubtless persuaded by Sir Joseph Banks, even raised a building for the purpose. After Sir Joseph's death, however, the scheme lapsed, and the building was granted to the King of Hanover. On his decease, Sir William Hooker urged the fulfillment of the old design, and his petition was granted when Mr. Bentham and Dr. Bromfield bequeathed their collections to the nation. The Herbarium of Kew is the largest in the world, and by far the most useful, because it is also most admirably arranged. The number of specimens in it is not on record. At Sir William Hooker's death, twenty-four years ago a rough estimate made the number a million, exclusive of duplicates. The written catalogue fills two gigantic volumes, and has to be continually posted up, for the collection increases by twenty thousand or so yearly. The dried plants in their portfolios stand in cases, and all are arranged upon the system of Sir Joseph Hooker's great work, the Genera Plantarum. The student has only to give the number attached to any genus in that book, and the case is unlocked and the portfolio laid before him in a moment. There are no formalities to check the young scholar here. He has but to present his credentials to Prof. Oliver, keeper of the herbarium, sign his name, and get to work. There are interesting features at every step of this noble collection, fascinating bits of history connected with every group of cases which bears the name of some distinguished botanist, the fruits of whose life-long labor are stored here. Of all these, perhaps the herbarium of Dr. Lindley is the most attractive. It occupies only four small cabinets, but the contents will surpass the visitor's utmost expectations. On the lower floor is preparing the catalogue of all plants

known, for which Mr. Darwin left a bequest. Mr. Daydon Jackson, Secretary to the Linnæan Society, has had the work in hand over three years, and it is not nearly finished. He employs a staff at the British Museum also. The catalogue of the library is not printed, but is contained in a ponderous manuscript volume in the keeper's room. The books include, besides all modern volumes and pamphlets on botany, a great number of those antique curiosities which bibliomaniacs treasure.

The work at Kew covers a vast field. In the first place officially stand the botanic interests—to study new plants and class them. Next, where plants are wanted for cultivation, which can not be obtained readily in the market, or which the service of the public demands, the Royal Gardens will supply them if possible. Where diseases, vegetable or animal or insect pests, threaten local plantations, Kew will look into the matter and consult with experts at home. Kew is ready also to report and to obtain advice upon new-industries which those upon the spot suggest. Furthermore, it keeps an eye on all institutions of the same class throughout the British Empire, which act in concert with their great model in the mother-country, and through it with one another. Foreign institutions co-operate in like manner with Kew to a certain extent. From time to time the authorities of Kew publish a list of new plants, which at present seem to average five hundred to six hundred a quarter, including those renamed for scientific purposes. From time to time, also, they publish a list of the seeds matured in the Royal Gardens, which are exchanged, on application, with all regular correspondents. One of these seed-lists includes something like four thousand species. This magazine of seeds is collected, nominally, for the benefit of institutions which may be able some time to return the favor in part, but in practice no one who applies with a serious purpose for seeds or plants is refused. How the rapidly increasing population of the globe is to be provided with food and clothing is a problem which the authorities of Kew believe falls within their department. They welcome every vegetable product which is reported to have qualities that make it useful to mankind, whether as a food, a medicine, a convenience, or a substance useful in manufactures. They are glad to report upon specimens of such substances, or to obtain the reports of trustworthy experts.

The story of the cinchona plantations is a good instance of the work of the Royal Gardens. Some forty years ago both the English and the Dutch authorities in the East Indies took alarm at the growing price of quinine, due to the rapid decrease of the forests of cinchona in Peru. The Dutch moved first, and imported a great number of seeds and seedlings, which they planted in Java at a heavy cost. But, probably because they had no Kew to advise

them, the Dutch had chosen a species which was hardly worth growing, and the plantations have been long since uprooted. For some years the English Government confined itself to importing seeds and plants, which died on the passage to India. This was evidently futile, and Sir William Hooker urged a systematic procedure. Mr. Clements Markham, in 1859, was sent to Peru to collect seeds and young trees. When he returned, his precious stores were received at the Gardens, nursed, and transmitted to India with trifling loss. This effort was successful. In the plantations of Bengal, laid out and managed by officers recommended by Sir William Hooker, there were, at the date of the latest report, about five million trees. From Kew cinchona-trees have been distributed also to all parts of the world where there was a chance for successful cultivation. The plantations of Ceylon are only inferior to those of Bengal; in Jamaica the sales of bark exceed £5,000 a year; the tree has been introduced also into St. Helena, Trinidad, Mauritius, Cape of Good Hope, Queensland, and many other settlements. The output of the cinchona drugs from these sources up to 1880 was 87,704 pounds, which, taking quinine at an average value of two dollars an ounce, would represent $2,806,528.

Ipecacuanha is a plant scarcely less important than cinchona itself. But few members of the vegetable kingdom so absolutely refuse to exist under anything short of perfectly satisfactory conditions. In 1866 Sir Joseph Hooker sent a specimen to the Botanical Gardens at Calcutta, which promptly died. Then a struggle began in which the advantage was now on one side, then on the other. In 1875 the Director of the Calcutta Gardens triumphantly reported that he had one hundred thousand nice young plants, but in 1886 the strain received from Kew direct alone survived—less than five per cent—and all hope of successful cultivation in India has been abandoned long since. Plants had been sent out to Singapore, however, in 1875, with much more lively confidence, and there perseverance found its reward. Ipecacuanha is established in the Old World at last, and the authorities of Kew may be trusted to diffuse the cultivation. Another instance is Liberian coffee, distributed from Kew to take the place of that grown in the East Indies, which was affected by a fungoid pest, and that of the West Indies, which suffered from the white fly. Liberian coffee, moreover, will thrive in hot and moist situations, where the Arabian variety is unable even to live. It has been introduced in a great many places, but, although its growth is very promising, it has nowhere become the general crop. This imperfect success was another problem for the investigators of Kew, and the solution is now believed to be found in the fact that the treatment proper for the Arabian berry after gathering is not suited to the Liberian, with a widely different pulp.

Among the many questions sent to Kew from all parts of the world, there must be some of trivial importance, or which could be perfectly well answered at the local botanic gardens. But all genuine inquiries receive attention. Debate has been gravely held, opinions even have been formed and reported upon such matters as a South African cane which some gentleman in those distant parts thought adapted for fishing-rods; upon the value of West African palm-kernels as material for coat-buttons; upon a pithy stem which the government of a West India island believed suitable for razor-strops.

One function of a national institution very seriously regarded at Kew is the training of young men to fill botanic situations in the colonies. Something is demanded of such young men beyond the practical knowledge which suffices at home. Instruction is given them in the principles of scientific botany, and those general conditions which rule the practice of horticulture under differing circumstances. The advantage of this system all around scarcely needs illustration. While serving the interest of the colonies, it increases the sources of information for Kew, since all these emigrants keep up more or less of a correspondence with the institution in which they were trained.

The village of Kew lies on the south side of the Thames, about six miles westward from Hyde Park Corner in London. "The Gardens" are a favorite resort for holiday-makers and tourists, being visited by six or seven hundred thousand persons yearly. Painters also flock there in summer-time. When the crown surrendered its rights to them in 1840, the Gardens had an area of eleven acres, and contained ten greenhouses of one sort or another. Sir William Hooker promptly begged permission to annex the Orangery and the land adjacent; then a part of the Pleasure Grounds; and after that the Royal Kitchen and Forcing Grounds. All these petitions being granted, by 1847 the Gardens had reached their present dimensions—about seventy acres. Three years later the rest of the Pleasure Grounds was granted for the establishment of an Arboretum, making the total area little less than two hundred and fifty acres. "The Arboretum is the richest in Europe, no doubt," says the writer in The Saturday Review, "but probably inferior to that of Harvard University, where special attention has been paid to this department." This admission in a British journal, and The Saturday Review above all others, should be very gratifying to Americans. The failure of Kew's Arboretum to be the finest in the world is explained on the ground that the soil—sandy and shallow, resting on a stratum of gravel—is unsuited to many kinds of trees. In former times, also, when an imperial collection had to be got together as quickly as possible, and as cheaply, specimens

were not planted with the care which might have overcome the disadvantage. It became necessary to reconstruct the Arboretum twenty years ago on this account. A singular example of the influence of fashion in gardening then came to light. The British public had been running after evergreens so hotly that nurserymen had ceased to grow deciduous species. It seems incredible that the authorities of Kew should have asked in vain for months throughout England, Scotland, and Ireland, for young aspens. As for American oaks, maples, etc., they absolutely could not be found in the kingdom. Unscientific lovers of the beautiful may rejoice that it has not yet been found necessary to interfere with the old forest trees, planted, perhaps, by Lord Capel. The new-comers are arranged by genus—all the willows, for example, with the alders, around the pretty lake, pines here, cedars there, oaks, nuts, maples, tamarisks, camellias, ranunculus, etc., etc.

In the Garden proper the smaller plants are found in bewildering array. No list of the species represented at Kew has been taken since that of the younger Aiton in 1810, but one is now being made. Some departments have been catalogued already. Of orchids, there are about 1,400 species; ferns, 1,100; stove plants, 2,500; succulents, 1,000; palms and cycads, 500; greenhouse plants, 3,000; herbaceous, 4,000; trees and shrubs, 3,000; in several cases, however, the figure is but a guess as yet. The total, great as it will prove to be, bears but a small proportion to the sum of Nature's wealth. If we take the flowering plants alone, as enumerated in Bentham and Hooker's Genera Plantarum, there are two hundred natural orders, 10,000 genera, and 100,000 species; and this leaves out of account the ferns and all the lower orders of *Cryptogamia*. The Economic Section has few visitors, and they are not tempted to carry exploration far. Not a few of the culinary and medicinal herbs in use are found here. If by some fatal chance the onion of commerce should be exterminated in the back-gardens of England, Kew is prepared to replace it. Side by side therewith grow the patience-dock and the skunk-cabbage, the briony, the cuckoo-pint, the Japanese yam, and the all-good. In ferns the Kew collection is exceedingly rich. It has had three special benefactors in this department, to the first of whom, Mr. George C. Joad, the public is indebted for the charming rock-garden opened in 1881. Sir Joseph Hooker had long been working for one, and the bequest of Mr. Joad's collection of ferns brought the matter to a crisis. Dr. Cooper Forster was an enthusiast upon the culture of filmy ferns, and Mr. W. C. Carbonell was specially interested in the cultivation of hardy ferns, particularly in the crossing of them, and the development of sports. Both these gentlemen bequeathed their treasures for the nation's enjoyment when their own power of enjoying them ended.

The glass houses at Kew are extensive structures. The Winter Garden covers more than an acre and a half of ground. The Palm House is three hundred and sixty-two feet long and one hundred feet wide. The new Orchid House is one hundred and forty feet in length, adding the two wings together. This last is not wholly satisfactory—to the orchid enthusiast an orchid house never is, nor can be. Supplemented, however, by a low, neat range, from which the public is excluded, nearly all the 1,400 species which form the national collection thrive admirably. British orchidists are proud of Kew—nowadays—for it was not so satisfactory in this department a few years since.

SKETCH OF HENRY R. SCHOOLCRAFT.

MR. SCHOOLCRAFT was a conspicuous figure in the scientific life of the early part of the century. A pioneer in some fields, the immediate follower of the pioneers in others, he was, in all the branches of research to which he gave attention, earnest, ready, diligent, sagacious, original, and modest. As among his titles to be remembered, the biographer who prefaces his Personal Memoirs names the early period at which he entered the field of observation in the United States as a naturalist; the enterprise he manifested in exploring the geography and geology of the Great West; and his subsequent researches as an ethnologist in investigating the Indian languages and history. "To him we are indebted for our first accounts of the geological constitution and the mineral wealth and resources of the great valley beyond the Alleghanies, and he is the discoverer of the actual source of the Mississippi River in Itasca Lake. For many years, beginning with 1817, he stirred up a zeal for natural history from one end of the land to the other, and, after his settlement in the West, he was a point of approach for correspondents"—on these topics and for all the Indian tribes.

HENRY ROWE SCHOOLCRAFT was born in Albany County, N. Y., March 28, 1793, and died in Washington, D. C., December 10, 1864. He was the descendant, in the third generation, of an Englishman, James Calcraft, who, having served with credit in the armies of the Duke of Marlborough, came to America in the reign of George II, in the military service, and was present at operations connected with the building of Forts Anne, Edward, and William Henry. After these campaigns he settled in Albany County as a land-surveyor, married, and in his old age conducted a large school—the first English school that was taught in that frontier region. In connection with this incident his name became

changed to Schoolcraft. He died at the age of one hundred and two years. John, his third son, was a soldier under Sir William Johnson. Lawrence, John's son, distinguished himself during the siege of Fort Stanwix. He was afterward director of the glass-works of the Hon. Jeremiah Van Rensselaer, at Hamilton, near Albany; and established the manufacture of glass in western New York.

Henry Schoolcraft spent his childhood and youth in Hamilton, cultivated poetry, and maintained an excellent standing in scholarship. At an early age he manifested a taste for mineralogy and natural science, which were then (about 1808) almost unknown in the country; formed the beginnings of collections; and organized an association for mental improvement. He investigated the drift stratum of Albany County as seen in the bed of Norman's Kill; and afterward, while living at Lake Dunmore, Vt., put himself under the teaching of Prof. Hall, of Middlebury College; added chemistry, natural philosophy, and medicine to his studies; erected a chemical furnace, and went into experimenting; and picked up a knowledge of Hebrew, German, and French. He began writing for books and periodicals in 1808—contributing, among other things, papers on the Burning Springs of western New York, and on archæological discoveries that had been made in Hamburg, Erie County. In the last paper, which was published at Utica in 1817, he pointed out the necessity of discriminating between the antique French and European, and the aboriginal period, in American antiquity. He was engaged for a time in directing the building of works connected with his father's glass-making enterprises in Vermont, New Hampshire, and western New York. The ideas and knowledge gained in these operations supplied the material for his proposed work on Vitreology, or the application of chemistry to glass-making, the publication of which was begun in 1817. The supervision of these works required the making of considerable journeys, and these created in him the desire to travel through the wilds of the "Far West," which then hardly extended beyond the Missouri River.

He made some "preliminary explorations" to his contemplated journey in western New York in 1816 and 1817, and started from Olean on the Alleghany River for a journey down the Ohio and up the Mississippi in 1818. A large company of intending emigrants had gathered there waiting for the season to open, and Schoolcraft took passage in the first ark. Arrived at Pittsburg, he stopped to explore the geology of the Monongahela Valley, and was greatly interested in the rich coal and iron beds. He stopped to visit the Grave Creek mound and the ancient works at Marietta. At Louisville he found "organic remains" of several spe-

cies in the limestone rocks of the falls, and published anonymously in the paper some notices of its mineralogy. At the mouth of the Cumberland River he exchanged the ark for a keelboat or barge, with which, propelled by poles pushing on the bottom, he made from three to ten miles a day against the swift current of the Mississippi to Herculaneum, Mo. On this voyage he traveled over a large part of the west bank on foot, and gleaned several facts in its mineralogy and geology which made it an initial point in his future observations. He spent three months in examining the lead mines, personally visiting every mine or digging of consequence in the Missouri country and tracing its geological relations into Arkansas. Hearing of syenite suitable for millstones on the St. Francis, he visited that stream and discovered the primitive tract; and he pushed his examinations west beyond the line of settlement into the Ozark Mountains. He now determined to call the attention of the Government to the importance of its taking care of its domain in the mines, and with this purpose packed his collections and took passage in the new steamer St. Louis for New Orleans. Hence, having inquired into the formation of the delta of the Mississippi, he sailed by brig for New York. He opened his collections and invited examination of them, published a book on the mines and physical geography of the West and a letter on its resources, and went to Washington to present his views on the care of the mines to the officers of the Government. While he was looking for a secretary within whose purview the matter fell, Mr. Calhoun invited him to accompany General Cass, Governor of Michigan, as naturalist and mineralogist on an expedition to explore the sources of the Mississippi and to inquire into the supposed value of the Lake Superior copper mines. He accepted the position, though the compensation was small, because, he says, "it seemed to be the bottom step of a ladder which I ought to climb."

Mr. Schoolcraft left New York in March, 1820, reached Niagara Falls on the 1st of May, and Detroit by steamer a week later. While waiting for the completion of arrangements for embarkation, he attended to the correspondence which had been provoked by the publication of his work on the mines and the resultant awakening of interest in the varied resources of the Mississippi Valley and the subject of geographical and geological explorations. He determined to reply to all letters that appeared to be honest inquiries for geographical facts, "which I only, and not books, could communicate." The route of the expedition "lay up the Detroit and St. Clair Rivers and around the southern shores of Lakes Huron and Superior to Fond du Lac, thence up the St. Louis River in its rugged passage through the Cabotian Mountains to the Savannah summit which divides the Great Lakes

from the Mississippi Valley. The latter was entered through the Cantaguma or Sandy Lake River. From this point the source of the Mississippi was sought up rapids and falls and through lakes and savannahs, in which the channel winds. We passed the inlet of Leech Lake, which was fixed upon by Lieutenant Pike as its probable source, and traced it through Little Lake Winnipeg to the inlet of Turtle Lake in upper Red Cedar or Cass Lake in latitude 47°. On reaching this point the waters were found unfavorable to proceeding higher. The river was then descended to the falls of St. Anthony, St. Peter's, and Prairie du Chien. From the latter point we ascended the Wisconsin to the portage into Fox River, and descended the latter to Green Bay." At this point the expedition was divided. The party to which Mr. Schoolcraft was attached proceeded to Chicago, thence traced the eastern coast of Michigan, and rejoined the other party, which had gone north to trace the shores to Michilimackinack. About four thousand miles were traversed. Reports were made to the Government by Mr. Schoolcraft on the mineralogy and geology of the region; on the copper deposits of Lake Superior; on the botany, fresh-water conchology, zoölogy, and ichthyology; soil, productions, and climate received attention; and the Indian tribes were subjects of observation by General Cass. "In short, no exploration had before been made which so completely revealed the features and physical geography of so large a portion of the public domain." A new interest in mineralogy and geology was awakened by this expedition, and Mr. Schoolcraft's narrative of it was hurried into press under the pressure of the public clamor for its results. The book was published in May, 1821.

Mr. Schoolcraft shortly afterward embarked, with General Cass, on another expedition. The route lay from the present site of Toledo, up the Miami of the lakes, down the Wabash and Ohio to Shawneetown, overland across the "knobs" and prairies, taking a famous locality of fluor-spar on the way, to St. Louis; thence up the Illinois to the rapids and on horseback to Chicago, stopping to find the fossil tree in the bed of the Des Plaines. In Chicago, a treaty was made with the Pottawattamies for the surrender of about five million acres of land, to which Mr. Schoolcraft should have given his signature among the others, but he was too ill—"did not, indeed, ever expect to make another entry in a human journal." The incidents and observations of the journey have been published as Travels in the Central Portions of the Mississippi Valley. In the next year (1822) Mr. Schoolcraft was appointed Indian agent at Sault Ste. Marie, of which he says, giving his reasons for accepting it: "I had now attained a fixed position; not such as I desired in the outset and had striven for, but one that offered an interesting class of duties, in the performance

of which there was a wide field for honorable exertion, and, if it was embraced, also of historical inquiry and research. The taste for natural history might certainly be transferred to that point, where the opportunity for discovery was the greatest." The position afforded him excellent opportunities for studying the Chippewa language and Indian mythology and superstition, characteristics, and customs, of which he made the best use. He determined to be a laborer in the new field of Indian studies. His diary during the whole term of his office shows him leading a busy and varied life. We find in it notes on his subjects of study, of his readings on various general topics, observations on the natural features of the region, remarks on mineralogical specimens, and incidents of official work.

Mr. Schoolcraft spent the winter of 1824–'25, on leave of absence, in New York, where he superintended the printing of his Travels in the Central Portions of the Mississippi Valley. "Society" was much interested in Mrs. Schoolcraft, the "Northern Pocahontas," a lady of aristocratic Irish descent on one side, and tracing her ancestors on the other side to the royal house of the Chippewas, who was withal, having been educated abroad, highly accomplished and refined in her manners. She was the daughter of Mr. John Johnston, of Sault Ste. Marie, who had married the daughter of Wabojeeg, a distinguished Chippewa chieftain. In 1825 he attended a convocation of the Indian tribes at Prairie du Chien, where a treaty was signed, through which it was hoped internal disputes between the tribes might be settled by fixing the boundaries to their respective territories. In the next year he attended a similar gathering of the Chippewa tribes at Fond du Lac, where the principles of the treaty of Prairie du Chien were reaffirmed, and a new treaty was made, under which the Indians acknowledged the sovereign authority of the United States; ceded the right to explore and take away the native copper and copper ores, and to work the mines and minerals in the country; and provision was made for the education of the Indians and their advancement in the arts. The system of Indian boundaries established by these treaties was completed by the treaty of Butte des Morts, August, 1827. The three treaties embodied a new course and policy for keeping the tribes in peace, and were founded "on the most enlarged consideration of the aboriginal right of fee simple to the soil." In 1827 he was elected a member of the Legislative Council of the newly organized Territory of Michigan—an office which was not solicited, and was not declined. As a member of this body during four sessions, he directed his attention to the incorporation of a historical society; to the preparation of a system of township names derived from the aboriginal languages; and to some efforts for bettering the condition of the natives.

A proposition was made to Mr. Schoolcraft in 1828 to go as one of the scientific corps of an exploring expedition which the Government contemplated sending to the south seas, under the direction of the Secretary of the Navy. In his reflections on the prospects of this expedition and the acquisitions to knowledge that might be expected to accrue from it, he regarded the experiments of Dr. Maskelyn, denoting a greater specific gravity in the central portion of the globe than in its crust, as opposed to a theory that was then advocated of an interior void. Yet he thought "we are advertised, by the phenomena of earthquakes, that this interior abounds with oxygen, hydrogen gas, caloric, and sulphur, and that extraordinary geological changes are affected by their action. It does seem improbable that the proposed expedition will trace any open connection with such an interior world; but it may accumulate facts of the highest importance." There was something, however, about the getting up and organization of the expedition which he did not like, and an apprehension whether Congress would not cripple it by voting meager supplies and outfits. He declined to go.

A note from Mr. G. W. Featherstonaugh, giving a disparaging view of American scientific achievement, and inclosing the prospectus of a journal designed to correct these things, gave Mr. Schoolcraft opportunity for bearing strong tribute to the genuineness of real American scientific research. The critic's remarks might be true as to a certain class, who had not made science a study; but, if applied to the power and determination of the American mind devoted to natural history, it was "not only unjust in a high degree, but an evidence of an overweening self-complaisance, imprecision of thought, or arrogance. No trait of the American scientific character has been more uniformly and highly approbated by the foreign journals of England, France, and Germany than its capacity to accumulate, discriminate, and describe facts. For fourteen years past, Silliman's Journal of Science, though not exclusively devoted to natural sciences, has kept both the scientific and the popular intelligent mind of the public well and accurately advised of the state of natural science the world over. Before it, Bruce's Mineralogical Journal, though continued but for a few years, was eminently scientific; and Cleaveland's Mineralogy has had the effect to diffuse scientific knowledge not only among men of science, but other classes of readers. In ornithology, in conchology, and especially in botany, geology, and mineralogy, American mind has proved itself eminently fitted for the highest tasks."

The Michigan Historical Society was founded, chiefly through Mr. Schoolcraft's instrumentality, in 1828, and the Algic Society on February 28, 1832. The latter organization had in view the

reclamation of the Indians, and, connected with this, the collection and dissemination of information respecting their language, history, traditions, customs, and character; their numbers and condition; the geological features of their country, and its natural history and productions. It also proposed some definite means of action for furthering the moral instruction of the Indians, and for helping the missionaries in all work for their benefit. As president of this society, Mr. Schoolcraft was asked to lecture on the grammatical construction of the Algonquin languages as spoken by the Northwestern tribes, and to procure a lexicon of it; also to deliver a poem on the Indian character at the annual meeting of 1833. Other literary efforts of this period were, an address before the Historical Society of Michigan in 1830, and an address, in 1831, before the Detroit Lyceum, on the natural history of the Territory. In the summer of 1832 Mr. Schoolcraft, under a commission from the Government, organized and commanded an expedition to the country upon the sources of the Mississippi River. The primary object of the expedition was to extend to the Indians living north of St. Anthony's Falls the measures previously taken with those south of that point, to effect a pacification; also, to endeavor to ascertain the actual source of the river. He ascended the St. Louis from Lake Superior to Sandy Lake summit, and passed thence direct to the Mississippi six degrees below the central island in Cass Lake, which was till then the ultimate point of geographical discovery. Thence he went up the river and its lakes, avoiding too long circuits of the stream by portages, to the junction of the two branches, where by the advice of his Indian guide he took the left-hand, or Plantagenian branch, to Lake Assawa, its source. Thence he went by portage, a distance of "twelve resting-places," to Itasca Lake, which he struck within a mile of its southern extremity. The lake was judged to be about seven miles in length, by one or two broad; "a bay, near its eastern end, gave it somewhat the shape of the letter *y*." The discoverer returned, through the stream and its lakes, to St. Peter's.

The narrative of this expedition was published in 1834; and was republished, with the account of the expedition of 1820, in 1853, under the title, Narrative of an Exploratory Expedition to the Sources of the Mississippi River in 1820, completed by the Discovery of its Origin in Itasca Lake in 1832. The whole of Mr. Schoolcraft's earlier life and work up to this time is recorded, mostly from day to day, in his Personal Memoirs of a Residence of Thirty Years with the Indian Tribes on the American Frontiers, etc., 1812 to 1842, a book having "the flavor of the time, with its motley incident on the frontier, with Indian chiefs, trappers, government employés, chance travelers, rising legislators, farmers, ministers of the gospel, all standing out with more or less of indi-

viduality in the formative period of the country." This book abounds with evidence of Mr. Schoolcraft's scientific and literary activity, as well as of his efficiency in work in whatever field. As early as 1820 we find a letter from Amos Eaton, asking him for information for the second edition of his Index to Geology, respecting the secondary and alluvial formations and the strata of the Rocky Mountains. Dr. Samuel Mitchell writes him, in 1821, about the shells and other specimens he has sent, including a "sandy fungus," and inviting specimens for the cabinet of the Emperor of Austria. Profs. Silliman and Hall acknowledge the value of his examination of the mining regions of Missouri; Prof. Silliman asks for articles for his journal; and Sir Humphry Davy thinks his book would sell well in England. Prof. Cleaveland writes him, in 1827, that he is about preparing a new edition of his work on mineralogy, and solicits the communication of new localities. In the same year Mr. Schoolcraft himself writes that the collection he made in Missouri, etc., in 1819, appears to have had an effect on the prevalent taste for those subjects, "and at least it has fixed the eyes of naturalists on my position on the frontiers." Mr. Peter S. Duponceau addresses him, in 1834, on the structure of the Indian languages, "in terms which are very complimentary, coming, as they do, as a voluntary tribute from a person whom I never saw, and who has taken the lead in investigations on this abstruse topic in America." He pronounces Mr. Schoolcraft's book on the Chippewa languages one of the most philosophical works on the Indian languages which he has ever read. In another letter Mr. Duponceau acknowledges having used Mr. Schoolcraft's grammar, giving due credit, in preparing a prize essay for the Institute of France, on the grammatical structure of Indian languages. Dr. Thomas H. Webb, of Providence, in 1835, notifies him of his election as an honorary member of the Rhode Island Historical Society, and asks about aboriginal inscriptions on rocks. The Massachusetts Historical Society, in 1836, asks him to proceed with his work on the Ojibway language, complete it, and let the society publish it. John J. Audubon asks for aid in preparing his work on American quadrupeds. There are numerous notices of specimens that have been sent to Mr. Schoolcraft to pass upon, and solicitations from persons representing the principal magazines, to contribute of the results of his researches.

A new disposition of official posts having been made, Mr. Schoolcraft transferred his residence in 1837 to Michilimackinac or Mackinaw. Thence he removed, in 1841, to New York, where he expected to find the surroundings more favorable to the collation and publication of the results of his observations on the red race, whom he "had found in many traits a subject of deep

interest; in some things wholly misunderstood and misrepresented; and altogether an object of the highest humanitarian interest." But the publishers were not yet prepared in their views to undertake anything corresponding to his ideas. In the next year he carried out a long-deferred purpose of visiting England and continental Europe, attending the British Association at Manchester. On his return he made a tour through western Virginia, Ohio, and Canada. In 1875 he was appointed by the Legislature of New York as a commissioner to take the census of the Indians of the State, and collect information concerning the Six Nations. The results of this investigation were embodied in his Notes on the Iroquois, a second enlarged edition of which was published in 1847. The latter part of his life was spent in the preparation—under an act passed by Congress in 1847—of an elaborate work on all the Indian tribes of the country, based upon information obtained through the reports of the Indian Bureau. This work—which was published in six quarto volumes—is described in Duyckink's Cyclopædia of American Literature as covering a wide range of subjects in the general history of the race; their traditions and associations with the whites; their special antiquities in the several departments of archæology in relation to the arts; their government, manners, and customs; their physiological and ethnological peculiarities as individuals and nations; their intellectual and moral cultivation; their statistics of population; and their geographical position, past and present.

Mr. Schoolcraft became interested in religion at an early period in his career, and his journals show him ever more earnestly co-operating in local religious movements; furthering the progress of missionary effort among the Indians, by whatever denomination; laboring for the promotion of temperance among them; and taking the lead in whatever might contribute to their well-being or to the repression of wrong against them. His literary activity was prolific, and appears to have been nearly evenly divided between poetry, Indian lore and ethnology, and the objects of his explorations and scientific investigation. Besides books of poems and the narratives already named, he published Algic Researches, a collection of Indian allegories and legends (1839); Oneota, or the Characteristics of the Red Race in America (1844–'45), republished in 1848 as The Indian and his Wigwam; Report on Aboriginal Names and the Geographical Terminology of New York (1845); Plan for investigating American Ethnology (1846); The Red Race of America (1847); A Bibliography of the Indian Tongues of the United States (1849); and American Indians, their History, Condition, and Prospects (1850). He received the degree of LL. D. from the University of Geneva in 1846; and was a member of many learned societies.

CORRESPONDENCE.

AGRICULTURE ON THE PLAINS.

Editor Popular Science Monthly:

IN the February number of The Popular Science Monthly was published an article, by Stuart O. Henry, entitled Rainfall on the Plains. Mr. Henry claims that the rainfall on our plains has not increased to any appreciable extent since the first settlement; and he says that the general impression that settlement and cultivation traveling westward have been attended by a gradual increase of rainfalls is a "remarkable fallacy." He concludes that agricultural operations can never be successfully carried on west of a line about the ninety-eighth meridian, and that attempts to utilize the regions named for purely agricultural purposes, without artificial irrigation, will only result in calamitous failure. Mr. Henry makes the statement that "the reports of the Kansas and Nebraska Boards of Agriculture will show that, in the territory lying west of the ninety-eighth meridian in those States, the acreage of land actually under cultivation, when compared with the whole area of that territory, is almost insignificant." After seventeen years of residence in southwestern Nebraska, near the one hundredth meridian, I am convinced that Mr. Henry is correct as to the absence of an increase of rainfall; but his conclusions are very erroneous, and must have been formed without information as to the great growth in wealth and population in the region west of the ninety-eighth meridian during the last ten years. The statement that the cultivated land west of the ninety-eighth meridian in Kansas and Nebraska is insignificant when compared with the whole area of that territory may have been true ten years ago, but at the present time it is far from the truth. The writer believes that no increase of rainfall has ever been necessary to fit the country named for profitable farming, but that the rainfall has *always been sufficient*, and that the obstacles to farming that have existed resulted from the *newness* of the country, rather than from lack of rain, and that these obstacles are gradually disappearing as the country settles up, and will wholly disappear when the country becomes as densely settled as are the States of Iowa and Illinois.

Mr. Henry's gloomy statements seem like an echo of predictions made by sundry scientific gentlemen twenty years ago concerning the plains of Kansas and Nebraska; and he might be aptly compared to a modern Rip Van Winkle, who has just awakened after a twenty years' sleep, ignorant of the wonderful growth that the country west of the ninety-eighth meridian has made. When he penned the lines quoted, was he aware that Jewell County, Kansas, which lies west of the ninety-eighth meridian, is the champion corn-producing county in the Union? Was he aware that nearly one half of the wealth and population of the State of Nebraska is to be found west of the ninety-eighth meridian? The report of the Nebraska Board of Agriculture for the year 1889 has not been issued, but we have the report for 1888. The crops in Nebraska in 1888 were not as good as in 1889, nor was there as much ground in cultivation. I give below some statistics taken from the report for 1888 making a comparative statement of the amount of wheat, corn, and potatoes raised east of the ninety-eighth meridian and west of that meridian in the State of Nebraska. It will be admitted by all that wheat, corn, and potatoes require as much moisture as do any farm products. It must be borne in mind that many of the western counties are very new and their capabilities not developed; but enough is shown to completely disprove Mr. Henry's statements. In the counties of Nebraska that lie *west* of the ninety-eighth meridian there were raised in 1888 of corn, wheat, and potatoes:

Corn	52,847,469 bushels
Wheat	7,088,688 "
Potatoes	8,626,145 "

In the counties in Nebraska lying east of the ninety-eighth meridian there were raised in 1888:

Corn	93,379,370 bushels
Wheat	4,876,190 "
Potatoes	2,724,996 "

It will thus be seen that the counties west of the ninety-eighth meridian produced about thirty-six per cent of all the corn, about sixty per cent of all the wheat, and about seventy-six per cent of all the potatoes that were raised in 1888 in Nebraska, and as a matter of fact a good portion was raised west of the one hundredth meridian. Reference to the same report shows that in 1888 there were 2,611,337 acres of improved land in the Nebraska counties lying west of the ninety-eighth meridian. These statistics clearly demonstrate that the improvements there made are far from "insignificant," and, could the statistics for 1889 be had, we would, without doubt, have a still more encouraging showing. A. E. HARVEY.

ORLEANS, NEBRASKA, *March* 26, 1890.

PUBLIC SCHOOLS AS AFFECTING CRIME AND VICE.

Editor Popular Science Monthly:

UNDER the above heading Mr. Reece presented some statistics in The Popular Science Monthly for January, apparently showing a high and increasing per cent of crime in those communities where there

were the fewest illiterates as compared with those where there were the most. In the succeeding numbers of the Monthly two writers, apparently accepting the statistics without question, have proceeded to draw conclusions from them. Some one has wittily said that "nothing can lie like figures"; and certainly any one who deals much with statistics knows that unless carefully and thoughtfully handled they are capable of giving the most deceptive results. For this reason startling conclusions should not be accepted without careful consideration. There is getting to be too wide a tendency to accept statistics as decisive proof on any subject without regard to how they were prepared or discussed.

In the January Lend a Hand, Mr. David C. Torrey carefully discussed the records of crime in Massachusetts, which was one of the States where Mr. Reece found his highest per cent of criminals, and some of his results seem worthy of quoting, as throwing much light on this subject:

From 1850 to 1885 the total commitments increased from 8,761 to 26,651; in the first-mentioned year, 1 to 118 inhabitants; in the second, 1 to 72 inhabitants. It is found, however, on investigation, that the increase is almost entirely confined to crimes against public order and decency, while the commitments for the more serious crimes against persons and property have not even kept pace with the growth of population. The following statistics for the years since 1865 in which a census has been taken proves this statement. This division by crimes was first made in the returns to the State in 1865, and was not made in 1875:

YEAR.	COMMITMENTS FOR CRIMES AGAINST	
	Persons and property.	Order and decency.
1865	3,975	5,760
1870	5,097	11,290
1880	3,779	13,274
1885	4,589	21,812

For the more serious crimes in 1865 and 1870, the average commitments were 1 to 801 inhabitants, while in the years 1880 and 1885 they were 1 to 496 inhabitants. The increase in commitments was for less serious crimes exclusively, and there was an actual decrease in commitments for more serious crimes, in proportion to population, of forty-four per cent. The larger portion of the less serious crimes, those for which commitments are increasing, are crimes of intemperance; so Mr. Torrey makes a second division of crimes, separating those of intemperance from all other crimes. The returns to the State permit of this division for a longer period:

YEAR.	Commitments for intemperance.	Commitments for all other crimes.	Total commitments.
1850	3,841	5,420	8,761
1855	8,221	7,811	16,032
1860	3,442	8,322	11,764
1865	4,302	5,616	9,918
1870	9,320	7,250	16,600
1875	.....	.....	24,548
1880	10,902	6,091	17,058
1885	18,701	7,950	26,651

This division shows that the total increase in all crimes other than intemperance, taken together, has been only fifty per cent (population not considered), but that commitments for intemperance have increased nearly five hundred per cent. The commitments which were not for intemperance are compared with the population of the State with the following results: In 1850, 1 commitment to 188 inhabitants; in 1855, 1 to 144; in 1860, 1 to 147; in 1865, 1 to 225; in 1870, 1 to 201; in 1875, no statistics; in 1880, 1 to 280; in 1885, 1 to 244. From 1850 to 1865 the average commitments for crimes other than intemperance were 1 to 174 inhabitants, while from 1870 to 1885 it was 1 to 241 inhabitants. Thus a decrease of thirty-eight per cent is shown in all crimes other than intemperance during a period of seventeen years.

The question of crime in Massachusetts thus resolves itself into a question of intemperance, pure and simple for it is owing to intemperance alone that there is an increase of commitments. Mr. Torrey proceeds to show that the increasing commitments for intemperance do not necessarily prove an increase of intemperance. The public has a different opinion of the crime of intemperance from what it has of other crimes. The commitments for more serious crimes could not increase without an increase of those crimes; but, because so few of the men who drink to excess are committed, there is abundant opportunity for an increase in commitments for intemperance without an actual increase of intemperance. In thirty-five years public sentiment has been aroused against intemperance, and the increased commitments caused by this sentiment and the changes in law which it has brought about are the inadequate grounds which warrant claims that crime is increasing in Massachusetts. The State seems still to have encouragement to continue its schools and its reformatories and its churches, with faith that it can not only take care of the children born to it, but also that it can assimilate to its social order those which it is forced to adopt.—*Boston Post.*

H. Helm Clayton,
Blue Hill Observatory, Readville, Mass., *March* 30, 1890.

EDITOR'S TABLE.

PRACTICAL ECONOMICS.

IN last month's Table we had a few words upon the discredit into which what is sometimes called the "orthodox" political economy has fallen among practical men. It is a pleasure to be able to call attention to a book which furnishes a signal example of the way in which economical studies should be pursued. We refer to the volume brought out a few months ago by Mr. D. A. Wells, under the title of Recent Economic Changes. Mr. Wells is not a dogmatist, though it is evident he has sufficiently definite opinions of his own. He conceives it to be his main business to marshal the facts that seem to him capable of explaining the present material condition of society, and of indicating the course that things are likely

to take in the future. He has no special theory to advocate, and he promises no speedy renovation of society if only his advice be taken. He knows too much to be a visionary; he has too firm a hold on the actual to be carried away by the merely ideal or fanciful. He finds no fatal flaw in the present social system; he does not see, in fact, how, given human nature as it is, things could be very different from what they are. At the same time he is an earnest believer in progress; but he thinks that progress depends more upon individual adaptation to necessary conditions of existence than upon any cunningly contrived devices for an improved distribution of the products of industry. In a word, he is a man whom the devourer of contemporary socialistic romances would find a little dull, but whom the practical man of business would find both interesting and instructive in the highest degree. As a large part of Mr. Wells's book appeared originally in the pages of this magazine, we may presume that many of our readers have a more or less vivid recollection of the course of his argument. What Mr. Wells set himself chiefly to do was to trace to its cause or causes the present disturbed condition of the world from an economic point of view. Given such a problem, a writer who wished to create an immediate sensation would bring forward some theory about the land, or about the currency, or about monopolies, or about the waste involved in competition, and would declare with much emphasis and vainglory that he alone had the true key to the whole situation. Mr. Wells is more modest. All he professes to see is that the rapid pace of invention and discovery in the modern world is sufficient to account for enormous vicissitudes both in the money market and in the labor market. Capital has been destroyed in huge blocks and recreated by new methods; labor has been forced to quit one employment after another and find new openings for itself. The course of business has become more and more difficult to calculate, and only the stronger heads and more resolute wills have been able to hold their own amid the changes and chances of the hour.

Mr. Wells does not deal in mere generalities. He treats separately each aspect of his subject, and under every head gives facts in abundance—"modern instances," as Shakespeare expresses it. He shows what has been done in the way of opening new routes; and, in the case of the Suez Canal, he traces to that one cause the most momentous results as regards the course of trade. He discusses very fully the effects of the cheapening of transportation by land and by sea, showing how, to this cause, must be attributed much of the agricultural depression existing in different parts of the world. He dwells on the inventions and discoveries by which manufactures have been cheapened, and labor constantly displaced and again provided for. He shows how improved methods of farming render less efficient ones unprofitable, and how little good has been done to the farming population by the homestead and other exceptional laws passed for their benefit—nay, how they have been injured by the overzeal of their friends in the Legislature. He discusses the effect of restrictions on trade, and shows in what idle fashion the governments of the world, with one or two exceptions, handicap their own commerce in the effort to injure that of their neighbors, and how the effect of the whole protectionist madness is simply to place a heavy drag upon the industrial energy, not to say upon the conscience, of mankind. We can not pretend, however, in this place to give even the most rapid summary of the contents of Mr. Wells's volume. Suffice it at present to say that he has described with great fullness and, so far as we can judge, with great accuracy, the conditions under which the business of the world is now being carried on, and the circumstances that have

concurred to make the present epoch one of peculiar commercial and industrial unrest.

What is the lesson, then, we are to draw from Mr. Wells's pages, so far as the social problems of our own time are concerned? We learn from it that there is nothing radically unsound in our social system; and, further, that the total effect of all the changes of the last twenty-five or thirty years has been to improve materially the condition of the working classes. Hours of labor are not as long on the whole as they used to be; wages are higher; and the purchasing power of money is greater. What is the case, however, is that, in the rush of change which has marked recent years, there is a constant selection and reselection of the better men, and that the worse—the less competent, the less efficient in every way—find themselves relegated to poorer conditions of life. There is an upward current and there is a downward current: those who move up do not spend much time or energy in singing the beauties of the present system; but those who are moving down waste no small amount of the little energy they have in bewailing its defects, and, with the help of a few literary gentlemen of lively sympathies and facile speech, manage to create a widespread impression that a world in which they do not get all they would like must be a very badly governed world indeed. The whole social question seems to lie here, that some, through natural deficiencies of one kind or another, can not, in any satisfactory degree, adapt themselves to the world as it is. We should be sorry to profess, or to feel, indifference to the problem even as thus stated; but what are we going to do about it? The true methods of reform are of slow application; and immediate suffering it is impossible altogether to prevent. The path of social reform, we are strongly persuaded, lies mainly along these three lines:

1. Diminution of state interference with private liberty, including state restrictions on trade and state encouragement of trade.

2. Constant inculcation of the doctrine of individual responsibility, and constant effort to mold better individuals.

3. An honest, vigorous, and simple administration of justice.

These three conditions (to which many minor but still important ones might be added) are all intimately connected. For example, how can we preach the doctrine of individual responsibility with any success, if the individual is daily surrounded by a closer and closer network of arbitrary enactments, designed at once to abridge his liberty and to relieve him of the exercise of judgment and caution? And how can we have a really efficient administration of law, till law itself undergoes a pruning, and is brought down to its necessary elements?

To return, however, to Mr. Wells's book. We are glad to see its merits very frankly acknowledged in an article published in the March number of Macmillan's Magazine, the writer declaring that Mr. Wells deals with his subject "in a manner altogether superior to anything which this country (England) can show." We shall only say in conclusion that the book is an eminently useful one to-day and will remain so for many years to come. A careful perusal of its pages would clear infected brains of many sickly fancies.

TRAINING IN REALITIES.

It is a long time since an earnest thinker proclaimed that wisdom was the principal thing, and that with all a man's gettings he should strive to get understanding; but whether the world to-day—even those who regard the utterance as carrying with it more than human authority—can be said to pay due heed to the maxim is more than doubtful. Instead of wisdom, men exalt opinion,

and traditions are taught where truth should be explored. We have large and influential schools decrying the use of reason, and we have millions of people to-day trying to think true what their common sense tells them is not true. All this does not make for the world's peace or stability. It will not be really well with society until men generally are brought to recognize that there is such a thing as truth, and that its claims upon them are paramount. Our systems of education need to be revolutionized. When a young person leaves school or college nowadays, do we expect to find that his or her judgment has been developed in practical things? Do we expect to find a keen sense of what is true, a quickness in distinguishing shams from realities, and a well-established habit of yielding, upon all disputed questions, to the greater weight of evidence? Nothing of the kind. We look for a little knowledge of arithmetic and mathematics generally, a modicum of geography and grammar, a smattering of literature, a few confused notions of natural science, a discontinuous skeleton of historical knowledge, and not much else. The judgment has not been trained, the sense of truth has not been trained, nor has any insight worth mentioning been given into the realities of life and duty. We do not blame the teaching fraternity for this; society as a whole is responsible. The want of interest in truth as truth, the lack of perception of its importance, is a broad social characteristic of the time, and floods the schools just as it floods the market-place, the press, and the pulpit. But, while we do not in any special manner blame the teaching profession, we feel like summoning all serious men to consider whether a very decided and vigorous effort should not be made to place our schools upon a higher level in this respect. No one can doubt that, if our minds were set upon it, a simple gymnastic might be devised which would, from the outset, train childish minds in the perception of truth and lead them on from stage to stage in the acquisition, not of sham but of real knowledge. A child in course of education should never be removed from actual contact with the world about him. He should be made to feel that every general rule given to him is merely a summary expression of a number of concrete examples. He should be early familiarized with the method of proof, and in every possible way encouraged to ask for proofs. He should be made to realize the activity of his own senses; to feel that knowledge is coming to him through those avenues; and that, only as it so comes, is it entitled to be considered real knowledge.

Such a system of education as we have hinted at would banish the intellectual poverty and squalor of our time; and this could not be done without an immense improvement of general social conditions. The sentimentalists of our day bestow a huge amount of sympathy upon the victims of poor wages; but they do not grieve as they might over the victims of poor thoughts and disordered imaginations. The dust and dirt heaps that obstruct the entrance to thousands of minds are not visible as material masses; but they are there all the same, and the injury they cause is greater than any due to mere limitation of material conditions. The land is full of delusions, and scarcely anywhere do we see any clear consciousness of the grand possibility open to the human race of co-operating in the discovery and application of truth, including, of course, and in the first place, the laws of social well-being. We too readily resign ourselves to the idea that men's opinions must differ by the whole circle of possible thought, and that a common standard of truth is unattainable. Well might the reproach be launched against this generation, "O ye of little faith!" Amid the manifold and ever-widening discoveries of science we resign ourselves to intellectual chaos, as if there were no common heritage of truth for us all, or as if human minds

were not all made essentially on the same pattern. What the times seem to call for is some association of men and women bent on nothing else than the introduction, primarily into our educational systems, but as much as possible into social life generally, of a supreme regard for that which is real.

LITERARY NOTICES.

PRACTICAL HINTS FOR THE TEACHERS OF PUBLIC SCHOOLS. By GEORGE HOWLAND. International Education Series, Vol. XIII. New York: D. Appleton & Co. Pp. 198. Price, $1.50.

THIS volume deals with the practice rather than with the theory of education. It tells what to do, and does not concern itself with any comprehensive scheme of educational philosophy. The author is superintendent of the public schools of Chicago, and the several chapters of this volume are based upon papers read before the teachers of that city and vicinity. The author has not aimed to produce an exhaustive and systematic treatise, but has confined his attention to the following ten topics: Moral training in city schools, the character of the teacher, the place of memory in school instruction, elements of growth in school-life, the scholarship aimed at in the school, the teacher in the school-room, how the school develops character, the class recitation, the school principal, and the work of the superintendent. The pages of the book are dominated by the personality of the author, and the things and practices recommended are such as his experience tells him are good. In regard to moral training, the subject that he treats first, he has no faith in text-books or special instruction; he would trust entirely to "the quiet suggestion, the fitly chosen word, the interested inquiry, the look, the unfeigned sympathy, the favored opportunity, the firm but calm decision of the loved and loving teacher." In other subjects, however, he would depend altogether upon books. The sesame to all progress, he says, is found inscribed on the printed page. In the six years before the child comes to school he has had a training without books which, as Mr. Howland affirms, has been very effective. "He has early learned that fire will burn, that cold will freeze, and knows, beyond the power of Webster or Worcester to tell him, the meaning of burn and freeze; and by many a bump has the force of attraction been impressed upon him." He has learned a language, and has acquired much other knowledge. By similar means the Indian acquires a wonderful training of his senses, his hands, and his mental powers. "He learns to do," says Mr. Howland, "in the only true way, by the doing." In acquiring a knowledge of language the author recommends this same process. Correct use of words and a nice appreciation of their meanings and force are to be secured, he says, "not from dictionary, but from use alone." That the teacher should learn by this method, however, he deems inadmissible. In his chapter on "The School Principal" he says: "We learn to do by doing, is one of those aphoristic half-truths well suited to catch the ear and delude the mind of the unthinking. We may acquire a mechanical facility by repeated doings of what we already know how to do, but we learn to do by learning how other people do, and by the aid of this knowledge striving to do something better." The volume is especially marked by an energetic character and a confident tone which assure the reader of the real interest of the author in the work of the teacher.

FIRST LESSONS IN POLITICAL ECONOMY. By FRANCIS A. WALKER. New York: Henry Holt & Co. Pp. 323. Price, $1.25.

THE special purpose of this book is to bring political economy within the grasp of youth from fifteen to seventeen years of age. The author has not made it childish by restricting himself to "words of two syllables," or by any similar device. The character which he has aimed to give the volume in order to adapt it to young pupils consists in "a clear arrangement of topics; a simple, direct, and forcible presentation of the questions successively raised; the avoidance, as far as possible, of certain metaphysical distinctions which the author has found very perplexing to students of even a greater age; a frequent repetition of cardinal doctrines; and, especially, a liberal use of concrete illustrations, drawn from facts of common

experience or observation." The fact that one purpose of the treatise is to interest beginners in the subject of political economy has also modified its character. "The author has not held himself, as strictly as he has sought in previous works to do, to the treatment of political economy as a science, to be distinguished from the art of political economy. He has allowed himself great freedom in assuming that certain results are desirable in themselves, and certain other results undesirable; and he has sought to show how these may be avoided and those attained. Much, which, in his other works, has been treated as belonging to the applications of political economy, is wrought into the substance of the present treatise." The work is divided into two chief parts, one treating of "Production and Exchange," the other of "Distribution and Consumption." Each section is numbered and has a title, and the volume is indexed.

FUEL AND ITS APPLICATIONS. By E. J. MILLS and F. J. ROWAN. Illustrated. Philadelphia: P. Blakiston, Son & Co. Pp. xx+802. Price, $7.50.

IT is one of the obstacles to gaining a competent knowledge of technology that its manuals become almost worthless when a few years old, but it is the glory of the sciences on which technology depends that they advance fast enough to make these books antiquated so quickly. This is especially true of the group of industries based upon the science of chemistry. In order to supply the lack of a comprehensive, authoritative *new* work dealing with these industries, a series of volumes has been projected, under the general title "CHEMICAL TECHNOLOGY, or Chemistry in its Applications to Arts and Manufactures." It will be edited by Charles E. Groves, F. R. S., editor of the "Journal of the Chemical Society," and William Thorp, B. Sc. As much of the matter of Richardson and Watts's "Chemical Technology" as is available, especially the historical portions, will be incorporated in the new work. Of this series the present volume is the first. The most important sections of the general field, to be covered in later volumes, are "Lighting," "Acids and Alkalies," "Glass and Pottery," "Metallurgy," "Textile Fabrics," "Leather, Paper, etc.," "Coloring Matters and Dyes," "Oils and Varnishes," "Brewing and Distilling," "Sugar, Starch, Flour," etc. The present volume treats of "Fuel and its Applications" generally; its special employment in various branches of chemical manufacture being preserved for detailed consideration in the volumes devoted to the special subjects enumerated above. In the chapters devoted to the production of fuel, tables are given showing the composition of the different woods and coals, together with information concerning the formation of peat, lignite, and coal, the world's production of coal, explosions in mines from fire-damp and coal-dust, etc. The figures representing the output of coal in Britain and other countries show the enormous development which has taken place in the fuel industry all over the world. Methods of burning charcoal, both in heaps and kilns; and methods of coking, in heaps and in ovens, are described, with illustrative views and diagrams. On the continent of Europe, methods of cleaning, washing, and classifying coal have reached a great degree of elaboration, and the practice in Britain has progressed somewhat in the same direction. Considerable space is devoted to these methods, and the machines employed in them. The most marked advance in respect to the manufacture and application of fuels in the past generation has been in the control and utilization of gases. The waste gases from coking ovens are now collected for their ammonia, tar, and other by-products, the gases from blast-furnaces using coal and from gas-producers are also made to yield these products; and great advance has been achieved in the extraction of ammonia in shale distillation. More important than these is the use of coal-gas, and in America of "natural" gas also, as fuel. The methods and appliances for using gaseous and also liquid fuel receive a general representation in this volume, and copious references are given for specialists who may wish to study particular branches of the subject. The portion of the volume devoted to the application of fuel is introduced by chapters on the theory of heat and the nature of flame. The matters of chimney-draught, forced combustion, and smoke prevention are then taken up. The special application of fuel considered first

is in domestic heating. The open fireplace and several ventilating fireplaces, and the "American" stove, are mentioned; but most space is given to gas heating and cooking stoves. Heating by means of hot air, hot water, and steam also receives attention. The application of fuel to vaporization, i. e., the heating of boilers, is next treated; and from this subject the authors pass to the evaporation of liquids and distillation. The drying of wood and malt, baking bread, and firing brick and porcelain, also have a place. Furnaces for metallurgical and other technological operations are next treated, and an important chapter follows on gas-furnaces, including those using the regenerative principle. The closing chapter deals with the practical effect of fuel. A series of tables giving analyses of coals follows. Throughout the book exact information in regard to the several divisions of the subject is furnished in tables and diagrams. The volume contains seven plates and six hundred and seven other illustrations, and is provided with an adequate index.

LIBERTY AND A LIVING. By PHILIP G. HUBERT, Jr. New York and London: G. P. Putnam's Sons. Pp. 239.

THIS book is described in its sub-title as the record of an attempt to secure bread and butter, sunshine and content, by gardening, fishing, and hunting. One of its mottoes is, "The royal peace of a rural home." The author, a writer on New York newspapers, wearied with the monotony and drudgery of city life, sought a way in which he could spend his time in the outdoor season profitably in the open air, and without giving up the winter residence in the city which his profession demanded. He found a place on the sea-coast of Long Island which afforded a home, garden, wood-lot, access to the water for boating and fishing, and hunting privileges. The book describes his life there, and the moral and practical lessons derived from it. The transcript of the diary of a week gives a realistic picture of the average life. The home and its arrangements, the garden-work and its returns, the fishing, the bee-raising, the advantages derived from the possession of a wood-lot, and the balance of advantages and disadvantages, are described in successive chapters. The balance is shown to be decidedly in favor of the country, pre-eminently so to those who seek quiet, rational enjoyment, with health, who desire leisurely culture without excitement, who are willing to live independently of fashion, and who do not attach an exaggerated importance to show.

JONATHAN EDWARDS. By ALEXANDER V. G. ALLEN, D. D. Boston and New York: Houghton, Mifflin & Co. Pp. 401. Price, $1.25.

THIS is the first volume of the series of "American Religious Leaders," or biographies of men who have had great influence on religious thought and life in the United States, in which it is intended, besides depicting great figures in American religious history, to indicate the leading characteristics of that history, the progress and process of religious philosophy in America, the various types of theology which have shaped or been shaped by the various churches, and the relation of these to the life and thought of the nation. The present volume relates to the earliest and probably the greatest of those leaders—the thinker who, along with Benjamin Franklin, American and foreign critics agree in naming as representative of American intellectual activity in the eighteenth century. Prof. Allen's aim in this biography has been "to reproduce Edwards from his books, making his treatises, in their chronological order, contribute to his portraiture as a man and as a theologian." Something more than a mere relation of facts seemed to be demanded in order to justify the endeavor to rewrite his life. What we most desire to know is, what he thought, and how he came to think as he did. "Edwards is always and everywhere interesting, whatever we may think of his theology. On literary and historical grounds alone no one can fail to be impressed with his imposing figure as he moves through the wilds of the New World." Edwards's life is full of dramatic incident, and his writings furnish ground for fruitful study—a study which he that would understand the significance of New England thought in the last century, and under its later aspects as well, will find indispensable. The summation of the result of Edwards's work is concluded with the assertion that "all who accept the truth that divine things are known to be divine be-

cause humanity is endowed with the gift of direct vision into divinity, are accepting what Edwards proclaimed, what constitutes the positive feature of his theology. There are those who have made the transition from the old Calvinism, through the mediation of this principle, to a larger theology as if by a natural process. Among these typical thinkers were Thomas Erskine, McLeod Campbell, and Bishop Ewing in Scotland, or the late Mr. Maurice in England. These and such as these, in whom the God-consciousness is supreme, are the true continuators of the work of Jonathan Edwards."

EXERCISES IN WOOD-WORKING; WITH A SHORT TREATISE ON WOOD. By IVIN SICKELS. New York: D. Appleton & Co. Pp. 158, with Plates.

THIS book is written for manual training classes in schools and colleges, having been prepared in the first instance in manuscript for the students in the College of the City of New York. The manuscript was copied for other schools. Many changes and additions were made under the suggestions of subsequent teaching; and it is now printed and published, for all who desire a volume of the kind. Being the product and result of work in teaching, it could hardly be other than a working book; and a working book, so far as it reveals itself to a critic's ken, it is. Its scope is the presentation of the facts which are most essential to the wood-worker's success and the good execution of his work, and of directions for the use of his tools and for manipulation. These facts and directions are given in a simple, concise style, intelligible to any pupil of ordinary sense. The book deals particularly with carpentry and joinery, and is divided into two parts. The first part treats of the structure, properties, and kinds of wood; its manufactures and economic relations to other substances; parasitic plants and insects, and means of preserving wood; under these heads are articles on the structure and composition of wood, branching of stems, age of trees, their decay, the season for cutting, milling, drying, and warping, the properties and defects of wood, its measure and values, and the kinds of wood. The several species used in wood-work, coarse and fine, are named and described; their value is estimated, their special qualities are pointed out, and the purposes indicated to which they are applied. This is followed by a tabular exhibit of the qualities of the various kinds of wood. A few words are given to the relations of wood and iron, and the wood-working trades are mentioned, and carpentry and joinery defined. A description of parasitic plants or fungi injurious to living trees and lumber follows; an account of injurious insects, prepared expressly for the book by Mr. Bashford Dean, and directions concerning the preservation of wood are given. The second part contains the exercises, preceded by a description of tools. The directions for the care and use of tools are explicit, and are illustrated by drawings representing the method of handling each tool, and the mark it makes. These exercises are followed by those concerning the forming and fixing of the several kinds of joints, gluing, making boxes, with hinging tops, drawers, and generally on uniting several pieces to make a complete structure; a series on the details of ordinary house carpentry, whence models may be constructed and the building of the various parts making up a wooden dwelling learned; the use of the frame-saw and methods of bending wood; pattern-work; shaping (boat model) by the use of templets; and veneering, with directions for painting and polishing.

THE NATIONAL MEDICAL DICTIONARY. Two vols. By JOHN S. BILLINGS, M. D., etc., and Collaborators. Philadelphia: Lea Brothers & Co. Price, $12.

THIS work aims to define "every medical term in current use in English, French, German, and Italian medical literature, including the Latin medical terminology of all of these languages." The pronunciation of English and Latin terms is indicated, and the derivation of most English and Anglicized Latin words (except names of drugs and plants) is given. The dictionary does not attempt to be cyclopedic, but gives simply brief definitions of the words and phrases included in its list. Prefixed to the first volume is a number of tables, including a table of doses, of antidotes, of the inch and metre system of numbering spectacle-glasses, of thermometric scales, of the average dimensions of the fœtus at different ages, of the average dimensions of the parts and organs of the adult human body, and of the weights of the

organs. Among these tables, also, there is a series, prepared by Prof. W. O. Atwater, showing the percentages of nutrient ingredients in a large number of food-materials, the fuel-values in the same, and standards for dietaries for different classes and occupations. Another table shows the expectation of life as derived from records of life-insurance companies, and from the last United States census.

THE ANATOMY OF THE FROG. By Dr. ALEXANDER ECKER. Translated, etc., by GEORGE HASLAM, M. D. Illustrated. Oxford: Clarendon Press; New York: Macmillan & Co. Pp. 449, with Colored Plates. Price, $5.25.

THE frog is aptly designated by the author as eminently the physiological domestic animal. It is kept in every physiological laboratory, and is daily sacrificed in numbers on the altar of science. The physiologist has recourse to it, not only to obtain answers to new questions, but for the sake of demonstrating easily and quickly the most important known facts of the science. It has furnished the means through which many most important discoveries in physiology have been made. It has "afforded almost the only material for the investigation of the excitability of nerves and its associated electromotive changes, and also no inconsiderable part of the remaining nerve and muscle physiology." Much of our knowledge of the functions of the spinal cord is derived from experiment upon it. Its muscles have served for the investigation of the phenomena and the conditions of contraction. But for the web of its foot and the gills and tail of its tadpole, "we should not perhaps for a long time have arrived at a satisfactory knowledge of the existence and the conditions of the capillary circulation. Acquaintance with the constituents of the blood directly concerned in nutrition; important facts in the physiology of the blood and lymph; and insight into the laws of the heart's action, have all been obtained by observations and experiments on the frog. To it, also, in histology, we owe much of our knowledge of the structure of nerve-fibers, their origin and termination, their relations within the ganglia, and the structure of muscular fiber; and for the study of reproduction and development the frog has, next to the chick, afforded the most important material." The importance of students being well acquainted with the anatomy and structure of an animal which plays so prominent a part in their researches is obvious; and it is this which Dr. Ecker, who is Professor of Human and Comparative Anatomy in the University of Freiberg, and Dr. Haslam, have furnished in the present book. The original work of Prof. Ecker was published in 1864. A second part, embodying, besides the author's work, fruits of the researches of Prof. Wiedersheim, appeared in 1881–'82. The translation was undertaken by Dr. Haslam at the suggestion of Prof. A. Gamgee, and was accepted by the delegates of the Clarendon Press as one of the series of Foreign Biological Memoirs published by them. But it soon became evident that a mere translation would be unsatisfactory, and that it would be desirable to recast and modify parts of the book, and to give descriptions of the minute structure of the several organs. The translator has included the results of recent researches, and has added facts derived from his own observations.

THE ELEMENTS OF ASTRONOMY. WITH AN URANOGRAPHY. By Prof. CHARLES A. YOUNG. Boston: Ginn & Co. Pp. 470. Price, $1.55.

PROF. YOUNG has prepared this text-book for use in high schools and academies, using in it much of the material and many of the illustrations of his larger work, General Astronomy. The author has tried to avoid going to an extreme in cutting down and simplifying, while giving a clear treatment of every subject. From the number of pages in the book it may be inferred that he has provided abundant material for a high-school course in astronomy. He has paid special attention to making all statements correct as far as they go, though many of them, on account of the elementary character of the book, are necessarily incomplete. No mathematics higher than elementary algebra and geometry is introduced into the text. In an appendix of some seventy pages, methods of making certain calculations and the construction of astronomical instruments are described. The Uranography comprises a brief description of the constellations visible in the United States, with four maps, from which the principal stars may be iden-

tified; also a list of such telescopic objects in each constellation as are easily found, and lie within the power of a small telescope. The volume is illustrated with one hundred and fifty-eight cuts.

AMERICAN SPIDERS AND THEIR SPINNING-WORK. Vol. I. By HENRY C. MCCOOK, D. D. Published by the Author: Academy of Natural Sciences, Philadelphia. Pp. 372. Price $30 (set of three volumes).

THE naturalist who takes dried or alcoholic specimens as the subjects of his study can prosecute his researches at all times and seasons, and independently of the will of the creatures that he is studying. But this advantage is offset by the limitation that the habits of the creatures, the kind of places they live in, the sort of structures they make, the way they move about, obtain their food, and rear their young, are a sealed book to him. The observations of the field naturalist, on the other hand, are attended by many more difficulties than those of the laboratory student. He must go to his specimens instead of having them brought to him. Perhaps they are not to be found at all seasons, and, when they are accessible, many hours must be spent in watching familiar actions in order not to miss a chance of seeing a new operation. He has the compensation, however, that he studies the creatures alive; hence the things which are hidden from the laboratory naturalist are revealed to him, and the knowledge that he gains arouses the widest interest and wins the greatest appreciation. The results which Dr. McCook lays before us in the present volume belong mainly in the latter class. They relate to the spinning-work of spiders, as performed in the making of webs and dens. With this is naturally connected some account of the methods of procuring food and the nesting-habits of these creatures, and the intelligence that they display in adapting their operations to particular circumstances. In order to give the reader a correct idea of how spiders form their threads, a fully illustrated chapter on the structure of the spinning-organs has been introduced. The whole work will be confined to the orb-weaving spiders of the United States, but a vast amount of material relating to other tribes, which the author has collected, has been drawn upon in order to make comparisons between the habits of the orb-weavers and other spiders. To the general reader, who sees no important difference between any two common wheel-shaped spider-webs, the distinct varieties of orb-weavers' snares described by Dr. McCook will be a revelation. Artists, too, who are supposed to be careful about the correct shapes of the things they draw, seem to have looked only carelessly at spiders' webs, for our author states that he has never seen but one in art work or book illustrations that gave proof of having been drawn from a natural web, by one who knew its characteristics. In three chapters the general features, the mode of constructing in detail, and the armature of orb-webs are presented. Passing to varieties of the orb, Dr. McCook describes the web with its center of closely woven silk tissue and a zigzag ribbon extending upward and downward, which is made by *Argiope*, a spider whose large size and beautiful markings make it conspicuous in our autumn fields. The round vertical webs made by *Epeïra* and other spiders are then touched upon. An account is given of the composite snares, which consist of a wheel-shaped web combined with a maze of intersecting lines; also of the sectoral orb, in which there is always one division of the wheel that is not crossed by the concentric rings.

Among the other peculiar features in webs that the author describes are the domed orb of the basilica spider, the ribbon decorations of the feather-foot, the triangle or part of a circle constructed by the triangle spider, and the somewhat irregularly radiating snare of the ray spider. A chapter on the engineering skill of spiders gives instances of their using weights to hold their webs taut, their placing of stay-lines in the best position allowed by circumstances, using unfamiliar substances for building a nest, etc. Especially interesting is a chapter on the mechanical strength of webs and the physical power of spiders, in which cases are given of spiders capturing and hoisting from the ground animals many times as large as themselves. Other topics that are fully treated, but which can be only mentioned here, are feeding habits, uses of poison, and nest-making habits. In a concluding chapter on the genesis of snares, the author traces the relations which exist between the various

forms of spinning-work treated in the foregoing pages. The volume contains three hundred and fifty-four illustrations, the author being convinced that a drawing is better to communicate some facts than pages of words. The pictures, moreover, are of artistic quality, and the mechanical work of the volume is of a high grade, making the book a remarkably handsome one. In the second volume of this work the author will treat the habits and industry associated with mating and maternal instincts, life of the young, etc. The third volume will be a systematic presentation of the orb-weavers of the United States, the descriptions being accompanied by a number of lithographic plates colored by hand. The work, aside from its scientific value and its popular interest, will be a treasure to the library of any one who secures a copy. The "author's edition" is limited to two hundred and fifty numbered copies, which are issued in cloth with uncut edges. A large part of the edition had been subscribed for before publication.

The *Report of S. P. Langley, Secretary of the Smithsonian Institution*, for 1889, states that the income of the Smithsonian fund is becoming less and less adequate for the work of the Institution with each year of the country's growth. This fund is now $703,000, of which only $1,500 have been received in bequests since the original Smithson legacy. The secretary calls attention to the Institution as a suitable trustee for moneys intended for the advancement of knowledge. Additional space is needed for exhibition purposes for the National Museum. The appropriation allowed for making the foreign exchanges required by Government does not cover what this service costs the Institution, even though free transportation is given by many steamship companies. The library received 17,354 accessions in the course of the year, and the collection is so large that much of it is inaccessible from lack of room. The collection of living animals, which numbers over three hundred, has outgrown its accommodations, and a scheme for creating a zoölogical park on Rock Creek, in the District of Columbia, is being agitated. The report includes statistics of publications of the Institution during the year, of accessions to the museum and to the library, and of international exchanges.

A great many facts which chemists constantly need to refer to are put into handy shape in the little pamphlet which Prof. *John H. Appleton* has published now for eight years, called the *Laboratory Year-Book* (G. Roscoe and Co., Providence, 12 cents). This publication contains a calendar, notes on the chemical work done in the preceding year, a list of new elements announced since 1877, a table based on the latest revision of atomic and molecular weights, tables of weights, measures, and thermometer scales and equivalents, the C. G. S. system of units, pronunciations of words used in chemistry, logarithms, postal regulations, etc.

The *Meteorological Observations made on the Summit of Pike's Peak, January, 1874, to June, 1888*, are published in the Annals of Harvard College Observatory, Vol. XXII. The observations were made and were prepared for the press by the United States Signal Service, and the expense of publication has been borne by the Boyden fund. The observations occupy four hundred and fifty-eight quarto pages, and are introduced and supplemented by a few pages of text.

The *Observations of the New England Meteorological Society* for 1888, published in the Annals of the Harvard College Observatory, contains tables in which the work of the society for the year is summarized. In a general account of the weather of the year it is stated that nine months were colder and three warmer than the average in New England. The total precipitation exceeded the usual annual fall by twenty-five per cent.

Among the papers that have appeared in recent numbers of *The Modern Science Essayist* (James H. West, Boston; 10 cents a number) is one on The Scope and Principles of the Evolution Philosophy, by Lewis G. Janes, the first lecture of the Brooklyn Ethical Association's second season. Dr. Janes represents evolution as a universal method, explaining the processes of all activity. He states the agnostic position in regard to the Unknowable Cause, and denies that the evolutionist is a materialist. In his closing paragraphs he points out the kind of aid that evolutionary philosophy can give to the solution of the problems of society. The

Moral and Religious Aspects of Herbert Spencer's Philosophy are presented in a paper by Sylvan Drey, under three heads: First, Spencer's theory of religion; second, Spencer's theory of morality; third, the relation of religion to morality from the Spencerian point of view. The object of the essay is exposition and not defense, and the author has the happy faculty of clear statement, which such work requires. In a lecture on Primitive Man, Z. Sidney Sampson sketches the life-record of man as it is revealed to us by the flint implements belonging to the Pleistocene and possibly to earlier geologic periods, by the articles found among the piles in the Swiss lakes, etc. The lecture is devoted mostly to the discoveries and conclusions relating to the earlier Old and New Stone Periods. C. Staniland Wake describes The Growth of the Marriage Relation, giving the attitude of primitive peoples toward consanguineous marriage, some of the varieties of polygyny and of polyandry that have obtained in various countries, and the chief features in the growth of monogamy.

Two successive volumes of the Questions of the Day series are devoted to "the railway problem." One of these, by Hon. *W. D. Dabney*, is entitled *The Public Regulation of Railways* (Putnams, $1.25). It deals with the commercial relations of the railways to the public, and does not take up the regulation of the roads with reference to safety and convenience. The author discusses first the legal aspects of the question and then its economic aspects. Under the former head are considered the sources of legislative power over railroads, and the limitations of this power arising from charter contracts, from the property rights of the owners of railways, and from the powers of Congress over interstate commerce. On these subjects, the decisions of the United States Supreme Court are taken as authority almost exclusively. On the economic side the discussion is based principally upon material contained in the reports and decisions of the Interstate Commerce Commission, and in the testimony and arguments presented to that body in the report made and testimony taken by the "Cullom Committee" of the Senate, and various other reports. The closing chapters contain a brief analysis of the Interstate Commerce Act, and a consideration of the relations of the express companies to the railways and to the people.

The phase of the subject dealt with by Mr. *John M. Bonham* concerns *Railway Secrecy and Trusts* (Putnams, $1.25). The secret discounts that railways make to certain monopolistic manufacturing corporations the author regards as the most serious feature of the railway problem. In his discussion of the subject he traces the growth of abuses in railroad management, showing that they owe their existence to the faulty system under which railroad charters have been granted. He states that the commissions that have been appointed to regulate great trusts and corporations fail to accomplish any reform because they have not the power to get at the secret agreements of these bodies, and he recommends a system of inspection which will prevent the unjust favoritism complained of.

The *Report of the Commissioner of Education for 1887–'88* is about as late in appearing as that of the preceding year, although it was completed three months earlier. The efforts and appeals of Commissioner *Dawson* for prompt publication of this document should meet with better success. Among the topics that receive special attention in the report are the condition and needs of education among the thousand Metlakahtla Indians, who have recently removed from British Columbia to an island near Sitka, also among the other inhabitants of Alaska. Manual training, industrial instruction, and education at the South, are also carefully reviewed.

A course of lectures on the *Constitutional History of the United States, as seen in the Development of American Law* (Putnams, $2), delivered at the University of Michigan, has been published in book form. The subjects and lecturers are as follows: The Federal Supreme Court: its Place in the American Constitutional System, by Judge Thomas M. Cooley; Constitutional Development in the United States as influenced by Chief-Justice Marshall, by Hon. Henry Hitchcock; as influenced by Chief-Justice Taney, by Hon. George W. Biddle; as influenced by the Decisions of the Supreme Court since 1865, by Prof. Charles A. Kent; and The State Judiciary:

its Place in the American Constitutional System, by Hon. Daniel H. Chamberlain.

The treatise on *Money*, by *James Platt* (Putnams, 75 cents), is historical, commercial, and economic in scope. It gives a sketch of the origin of money, after which the question, What is money? is discussed. The author defines money as "a commodity, of the same general nature as all other commodities." But he says that, although a wealth in itself, its utility consists in its ready convertibility. Paper is not money, according to his view. Considerable space is devoted to explanations and counsel about banking. Exchange and interest receive attention, and the author then proceeds to discuss wealth and capital. Some considerations on panics are given, with the aim of preventing the tight grip on money that always aggravates a panic. In the closing sections, means of attaining individual success and national prosperity are pointed out.

The History of Federal and State Aid to Higher Education in the United States has been prepared by *Frank W. Blackmar*, Ph. D., at the request of the Bureau of Education, as one of the series upon the history of higher education in the United States, authorized by the Secretary of the Interior. It is intended to represent the progress of the State idea in education from the foundation of the colonies to the present time. It discusses the rise of national education, with its relation to local, and brings forward the opinions of statesmen and scholars concerning the duties and functions of government in public education. A brief history is given of the methods adopted by Congress to encourage and assist institutions of learning, while the main body of the work is devoted to the presentation in a condensed form of the plans pursued by the Legislatures of thirty-eight States in the treatment of higher education. One of the strongest inferences drawn by Commissioner Dawson from the investigation is that in nearly every instance the foremost desire of the people has been for colleges and universities rather than for schools of a lower grade, the opinion having prevailed that primary and secondary schools were dependent for their existence on higher institutions.

The *Twenty-seventh Annual Report of the Massachusetts Agricultural College* gives an account of the work of the institution during 1889, with the usual information about course of study, professors, equipment, etc. Appended to this report is a paper by Prof. Paul Wagner, of Darmstadt, On the most Profitable Use of Commercial Manures, translated by Prof. Charles Wellington in answer to the demand for information on the subject.

In *The Evolution of a Life* (Holt Publishing Company, $2), *Henry Truro Bray* tells the story of his early life, of his career as a clergyman in the Methodist and then in the Episcopal Church, and of his being forced to leave the ministry on account of his growing disbelief in the supernatural doctrines of religion and his increasing disgust with the practices of church-members and men in holy orders. The experiences and incidents which are told in this volume under the veil of fictitious names exhibit many of the persons with whom Mr. Bray's labors brought him in contact in no very enviable light. The story, especially the part relating to the author's married life, reveals the joys and sorrows, hopes and fears, discouragements and triumphs of an affectionate, sensitive, and religious nature, which has been sadly torn by contact with the world.

Bulletin No. 7 of the *Iowa Agricultural Experiment Station* contains accounts of experiments and observations on seven subjects. The chief article is on varieties of corn, and is illustrated with four plates. The other topics treated are the millets, sugar from sorghum, the codling moth, new *Cynipidæ*, the hog-louse, and varieties of grapes.

The *Monthly Bulletin of the Iowa State Board of Health* (Des Moines, 25 cents a year) is a decidedly practical and wide-awake document. Each number is made up of brief and timely articles on hygienic subjects, replies to questions, reports of mortality, and of the appearance of contagious diseases within the State, etc. A Signal Corps meteorological report for each month is also included.

A brief account of *Massage and the Original Swedish Movements* has been prepared for physicians and others interested by *Kurre W. Ostrom* (Blakiston, 75 cents). It describes the operations of massage, with figures, and the various passive movements belonging to the Swedish system. Lists of

manipulations and movements suitable for a large number of diseases are given. In these applications Ling's and Mezger's systems have generally been followed. Some considerations in regard to the effects of exercise are included in the volume, and a caution against the untrained "rubbers" who form a large part of those who claim to be *masseurs* in America, or who use the name as a cloak for vice.

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POPULAR MISCELLANY.

Jacob Ennis.—This able but retiring man was born in Essex County, N. J., in 1807. He came of sturdy Scotch-Irish stock on his father's side, and was of Dutch extraction (the Doremuses) on his mother's side. After graduating at Rutgers College, and when yet quite a young man, he connected himself with the Dutch Reformed Church, and was by that organization sent to the islands of Java and Sumatra as a missionary, where he remained four years. Here his powers of observation and his love for the study of nature had an early development. Returning to his native country, he soon engaged in educational work, and was elected Professor of Natural Sciences in the National Military College of Bristol, Pa. Afterward he became principal and proprietor of the Scientific and Classical Institute of Philadelphia, where he spent the best part of his life. He also occupied for some years the chair of Physical Sciences in the State Normal School at Shippenburg, Pa. In his career as an educator, he from the start laid great stress on the importance of the study of nature, and was indeed a bold and fearless innovator in this respect, anticipating by perhaps a quarter of a century the recognition that scientific studies have subsequently had in all the highest institutions of learning. His life was quiet, simple, dignified, but laborious. He was a member of the chief scientific bodies both in this country and abroad, and his contributions in the shape of addresses before learned societies, pamphlets, and articles in scientific periodicals were many and varied, always strikingly original, often profound, and sometimes prophetic. Among these contributions, chiefly on astronomical problems, was one entitled The Two Great Works to be done on our Sidereal Systems. In this publication two questions are asked—First: Which way round does the great ring of the milky way revolve? Second: In which direction must we look for the center of our sidereal systems, and how far is it distant? These two questions he attempted to answer himself in an unpublished work, upon which he expended all the time and thought that he could command during the latter days of his life. He considered this the most important and certainly the most original and far-reaching of his works on astronomy, and it will no doubt be published in due time. In his book on The Origin of the Stars, published over twenty years ago, some of the most transcendental problems of physical astronomy were attacked and solved with a keen analysis, an abundance of facts, and a wealth of illustration worthy of a master of the science. Prof. Ennis's intellectual scope and sympathies were not narrow or one-sided; he was familiar with the entire range of English and classical literature, and was an excellent linguist. His literary style was simple, direct, and lucid; he had a great dislike for "big words," and always succeeded in making his ideas clear by the use of plain and untechnical language even when handling the most abstruse problems. His habits and tastes were simple, his wants few, his disposition kindly and gentle, and the attitude of his mind was distinctly reverent. He was so quiet, mod-

est, and unobtrusive that but few suspected the presence of a great thinker so near at home, and fewer still knew him personally. He died in Houston, Texas, January 12, 1890.

The Late Henry James Clark.—A biography and bibliography of Henry James Clark has been published by the Massachusetts Agricultural College, in which he was the first professor. He was born in 1826, began the study of botany under Asa Gray in 1850, and became a pupil and private assistant of Agassiz, who spoke of him in 1857 as "the most accurate observer in the country." He was in succession adjunct Professor of Zoölogy in Harvard University; Professor of Botany, Zoölogy, and Geology in the Agricultural College of Pennsylvania; Professor of Natural History in the University of Kentucky; and Professor of Comparative Anatomy and Veterinary Science in the Massachusetts Agricultural College; and he was a member, fellow, or correspondent of the principal American scientific societies, including the Academy of Sciences when its membership was limited to fifty. He assisted Agassiz in the preparation of parts of the Contributions to the Natural History of the United States; delivered lectures on histology and the Cambridge Museum of Comparative Zoölogy; and delivered a course of lectures at the Lowell Institute on Mind in Nature; or the Origin of Life, and the Mode of Development of Animals. He died on the first day of July, 1873, in the forty-eighth year of his age. The list of his scientific writings comprises twenty-seven titles, mos of which cover more than one article.

Educational Value of Manual Training.—The committee report of the National Council of Education on the Educational Value of Manual Training admits the reasonableness of substituting a system of manual training in special schools, in so far as it can be done, for the old system of apprenticeship, but insists that the training ought not to be begun before the completion of the pupil's twelfth year, nor before he has had the statutory instruction prescribed by the state in the intellectual branches of school work. It admits that manual training is an educative influence, and that, in so far as the schools teach the scientific principles that underlie the practical points of their work, they add intellectual education to physical education. The study of general scientific principles, according to Dr. William T. Harris's interpretation of the views of the report, would be educative in the first rank: they explain all machines and all natural phenomena in our present experience, and will explain those that we meet in the future. In the second rank are special applications of science in the form of theories of special machines, as, for example, of the steam-engine. These theories explain all machines made in accordance with them; they are very general, but not so general as the scientific theories of the forces involved. They are accordingly less educative. A third and least educative school exercise is the construction of a particular machine, when the theory is narrowed down to a special example. The laborer meets many new things in the work of constructing the machine, but unhappily they are not educative, because they are contingent, and do not assist in explaining or constructing the next machine. Examined in these three grades of educative value, the purely manual work of the school belongs to the lowest grade, and furnishes the obscurest knowledge of principles covered up by a mass of non-essential circumstances. The committee, however, lays stress on the importance of æsthetic culture through drawing. It is culture in taste that American workmen need, and not culture in skill, for our laborers are already ingenious and skillful and industrious. Drawing is the best means of acquiring familiarity with the conventional forms of beauty in ornament—forms that express the outlines of freedom and gracefulness, and charm all peoples, even those who have not the skill to produce them; and make markets for the articles that bear them.

Causes of Insanity.—The latest report of the British Commissioners of Lunacy gives tables showing the causes of insanity as verified by the medical officers of the institutions, in the cases of 136,478 patients who have been admitted into public and private asylums since 1887. The causes are classified as "moral" and "physical." As might

be expected, "intemperance in drink" heads the list of single causes, with 18,290 cases. Of "moral causes," "domestic trouble," "adverse circumstances," and "mental anxiety and worry, and overwork," are collectively held responsible for 25,897 cases. Of other moral causes, "religious excitement" is credited with 3,769 cases, "love affairs" with 2,224, and "fright and nervous shock" with 1,953. Of physical causes, "sexual diseases" are credited with 3,447 cases, "overexertion" with 761, "sunstroke" with 1,686, "accident or injury" with 4,199, "diseases of women" with 11,315, "old age" with 5,773, "privation and starvation" with 2,607, "fevers" with 880, "puberty" with 582, and "other bodily diseases or disorders" with 14,719. Previous attacks had occurred in 22,703 cases. Hereditary influence was ascertained in 28,063, and congenital defect in 5,881. As between the sexes, 66,918 were of the male and 69,560 of the female sex.

Rights on Other Men's Lands.—A paper by Mr. Hyde Clarke, on "The Rights of Property in Trees" on the land of another, relates to a curious custom of primeval times which still survives in some lands. The author first met it as a land judge in Asia Minor in 1862, when he was called upon to grant compensation for olive-trees belonging to one or more persons on the lands of others, and for honey-trees or hoards of wild honey in state or communal forests. Papers read by the Rev. Dr. Codington gave information of the existence of a like system in Melanesia. It likewise prevails, according to Mr. Crocker, of the British North Borneo Company, in Borneo, in respect to the *katapang*, or honey-tree, and also in the case of caves containing edible bird's-nests. Sir Spencer St. John also observes that in Borneo the land nominally belongs to the state or tribe, but the ownership is not a private property in land in our sense of the word. He had observed that certain of the *tapang*, on which the bees construct their nests, often belonged to special families, and were not touched by their neighbors. Sir Thomas Wade has found a similar right in China, where, when hill farms or gardens are leased, the tenant will pay the proprietor a yearly rent. All fir-trees or bamboos on the ground before it is let belong to the proprietors, and the tenant is not free to appropriate them. If there were no such trees on the ground when it was let, and such trees were subsequently planted by the tenant, they would be at his disposal. Separate property in trees is also traceable in India, particularly in Chota Nagpore, where Mr. J. F. Hewitt has frequently found that fruit trees growing on land are owned by persons other than the owners or cultivators of the soil. The *mhowa*-trees, which are exceedingly valuable, are frequently divided among the inhabitants of the villages near which they grow. This individual property in trees is not in Turkey confined to Asia Minor, but prevails as a general law in the empire. Miss Pauline Inby found it in Bosnia, and bought an interest of the kind in a certain estate. It seems also to have anciently existed in the British Islands, and is recognized in the Brehon records of Ireland. But there, and in most European countries, the vestiges of the separate rights have ceased to exist.

Soaping Geysers.—It has been often observed that throwing soap into the geysers of the Yellowstone Park will produce or hasten an outburst. The phenomenon has been investigated by Prof. Arnold Hague, of the United States Geological Survey, who finds that two conditions are essential to the production of an eruption in this way: first, the surface caldron or reservoir should hold but a small amount of water, exposing only a limited area to the atmosphere; and, second, that the water should stand at or above the boiling-point of water for the altitude of the geyser basin above sea-level. The latter is the principal factor. Many of the geysers and hot springs present the singular phenomena of pools of water heated above the theoretical boiling-point, and, unless disturbed, frequently remain so for many days without exhibiting any signs of ebullition. Thermal waters in this condition may be made to boil by other artificial means that will disturb their equilibrium, as by casting sinter into them, and, in one instance at least, by a strong temporary gust of wind. If soap or lye is thrown into most of the small pools, a viscous fluid is formed; and viscosity is, in

the opinion of the author, the principal cause in hastening geyser-action. It tends to cause the steam to be retained within the basin, and, when the temperature stands at or above the boiling-point, explosive liberation must follow. All alkaline solutions exhibit, by reason of this viscosity, a tendency to bump and boil irregularly. Viscosity in the hot springs must also tend to the formation of bubbles and foam when the steam rises to the surface, and this in turn aids to bring about the explosive action, followed by a relief of pressure, and thus to hasten the final and more powerful display. The practice of casting in soap is regarded as detrimental to the preservation of the geysers, and as a proper object of restriction.

The Nature of Poisoned Arrows.—The word poison, as applied to the poisoned arrows used in the Solomon Islands, Santa Cruz, the Banks Islands, and the New Hebrides, should be understood, according to the Rev. Dr. R. H. Codington, in a peculiar sense. The practice of administering poison in food was common among the natives, but it was doubtful whether what was used had much power of doing harm. The deadly effect was expected to follow from the incantations with which the poison was prepared. In the same way the deadly quality of the poisoned arrows was never thought by the natives to be due to poison in our sense of the word, though what was used might be, and was meant to be, injurious and active in inflaming the wound. It was the supernatural power that belonged to the human bone of which the arrow-head was made on which they chiefly relied, and with that the magical power of the incantations with which it was fastened to the shaft. The bone of any dead man will give efficacy in the native belief to the arrow, because any ghost may have power to work on the wounded man; but the bone of one who was powerful when alive is more valued. In Lepers' Island, a young man, out of affection for his dead brother, took up his bones and made them into arrows. He carried these about him, and did not speak of himself as "I," but as "we two"—his brother and himself—and he was much feared; all the supernatural power of the dead brother was with the living. Although it is the human bone that gives the deadly quality to the arrow, the bone must be prepared with certain incantations which add supernatural power. The poison is an addition to the power of the bone. The native did not much consider, if at all, the natural power to hurt, of either bone or poison. A dead man's bone made the wound, the power of the ghost was brought by incantation to the arrow, and therefore the wounded man would die. Euphorbia-juice is hot and inflaming; it is smeared on the bone with an incantation which calls in the power of a dead man's ghost; when the wound is given, the ghost will make it inflame. The cure of the wounded man is conducted on the same principle. If the arrow-head, or a part of it, can be recovered, it is kept in a damp place or on cool leaves; the inflammation of the wound is little, or subsides. Shells are kept rattling over the house where the man lives, to keep off the hostile ghost. In the same way the enemy who has inflicted the wound, and his friends, will drink hot and burning juices, and chew irritating leaves; pungent and bitter herbs will be burned to make an irritating smoke, and will be tied upon the bow that sent the arrow; the arrow-head, if recovered, will be put into the fire. The bow will be kept near the fire, and its string kept taut and occasionally pulled, to bring on tension of the nerves and the spasms of tetanus. Prof. Victor Horsley has suggested that the value of the human bone tipping the arrow was first made evident by the employment of a bone from a corpse recently dead, in the decomposing tissues of which the septicæmic virus would consequently be flourishing.

The Mesozoic Atlantic Coast Region.—In his address before the Geological Section of the American Association, Prof. Charles E. White, defining the Mesozoic formations of North America, said that the rocks of the Triassic age are found from Prince Edward Island to the Carolinas. They rest on formations, from the Archæan to the Carboniferous, inclusive. Very few invertebrate fossils have been found in the Trias of the Atlantic coast region, and these are of little value for indicating the age of the strata that contained them. Intermediate between the Triassic beds and the undisputed Cretaceous deposits of this region is a series of

strata of littoral and estuary origin, to which the name Potomac formation has been applied. These deposits are only a few hundred feet thick, and, though frequently covered from sight, seem to be continuous from New Jersey to Mississippi. Invertebrate fossils are rare, but large collections of fossil plants have been found in the Potomac region. The best authorities recognize several of these fossils as Jurassic. Briefly, then, the Mesozoic of the Atlantic coast region consists of a probable representation of the Upper Trias of Europe, a possible one of the Upper Jura, a probable slight one of the Middle Cretaceous, and a practically certain representation of a large part of the Upper Cretaceous, with a hiatus between the latter and the Eocene. The speaker advocated a system of classification more suited to this country than the European one. The time has come when North American geologists can and ought to hold a commanding position in this matter.

Olives and their Oil.—The olive has been cultivated in the regions of the Mediterranean coasts from time immemorial. Olive-oil there takes the place of butter. Spain has about 3,000,000 acres in olives, Italy 2,250,000, and France about 330,000 acres. Forty-five varieties of the fruit are described. The tree occasionally grows to be sixty feet high, and twelve feet in circumference of trunk. The varieties differ in the nature of the wood, the foliage, and the quality and shape of the fruit. The fruit is mild, or sharp, or bitter; and the oils differ likewise; so that a pure olive-oil may be unfit for purposes of food, and only fit for greasing machinery and making soap. The green, unripe olives, having had the bitter taste extracted with salt, are preserved in vinegar with spices. The ripe olives are gathered in the fall, when they are as large as common plums. They are of dark-green color, and the pit, now become a hard stone, contains a savory kernel. The flesh is spongy, and its little cells are filled with the mild oil, which runs out at the least pressure. The finest oil is the virgin oil which is made by collecting the freshly gathered olives in little heaps, and letting them press the oil out by their own weight. It is clear, and has a delicate, nutty taste, with little or no odor. When the fruits cease to give the oil by themselves, they are pressed with small millstones, yielding an oil which is also clear and has a pleasant taste. The olives, still rich in oil, are next put in sacks, boiling water is poured over them, and they are pressed once more. The oil gained by this process is yellowish-green, and has a sharp taste and an unpleasant smell. At Marseilles the olive-oils are classed into manufacturing oils for burning, greasing machinery, and soap-making; refined oil; oil from the pulp or husks, and table or edible oil. The last is superfine, fine, half fine, and ordinary. The table oil is refined by allowing it to run through layers of thin sheets of wadding into tin perforated boxes. The wadding absorbs all the thick particles, and leaves the oil clear and tasteless. The olive crop is variable and uncertain, and is seldom profitable more than once in six or eight years.

Avogadro.—According to a sketch published by Prof. Hugo Schiff, of Florence, in the "Chemiker Zeitung," Amadeo Count Avogadro, son of the magistrate Filippo Vercellone, was born in Turin, August 9, 1776. He studied jurisprudence at the Turin University, became Doctor of Laws on March 16, 1796, and then held a position under the Government till 1806, when he began his scientific career. In physics he was self-taught, and obtained a subordinate position in the Collegio delle Provincie in Turin, which was then and still is a richly endowed department of the Turin University. On November 7, 1809, he became Professor of Physics at the Gymnasium in Vercelli. In 1820 he was elected Professor of Mathematical Physics at the Turin University. Later this chair of instruction was abolished, and Avogadro resumed the practice of law. He was, however, reinstated in his chair through the influence of Charles Albert, and remained at the university till 1850, when he retired on account of old age and ill health. He died at Turin, July 9, 1856, at the age of eighty years. Avogadro was but little known in Italy and unknown in foreign countries. He shared with Charles Gerhard, who died in the same year, August 19, 1856, the same fate. It was only after death that their great and important contributions to science found recognition.

Atmospheric Nitrogen as Food for Plants.—The results of experiments at the agricultural stations at Middletown and Mansfield, Conn., are in favor of the value of atmospheric nitrogen as a food for plants. The conclusions are deduced from them by Prof. Atwater that many, if not most, of the leguminous plants are able to and do acquire large quantities of nitrogen from the air during their period of growth; and that there is some connection, not yet defined, between root-tubercles and the acquisition of this aliment. The cereals with which experiments have been completed have not manifested the same power, and they do not have such tubercles as are formed on the roots of the legumes. The addition of soil infusions did not seem necessary for the production of root-tubercles. The size and vigor of the plants, and their gain of nitrogen from the air, seemed to be proportional to the abundance of root-tubercles in the experiment. Losses of nitrogen sometimes occurred, but always in cases where there were no root-tubercles. The ability of legumes to gather nitrogen from the air helps to explain the usefulness of certain members of the family as renovating crops, and enforces the importance of using them to restore fertility to exhausted soils. Conversely, the loss of nitrogen suffered by some other crops, such as oats, suggests a possible reason why they should appear to be "exhausting" crops.

Coffee in Brazil.—The cultivation of coffee has been greatly extended in Brazil during recent years, chiefly in the southern provinces. The planting is done on freshly cleared ground after a single crop of Indian corn has been raised from it, either by sowing the seed directly or often by transplanting from slips grown in nursery rows. During the earlier years corn, beans, and occasionally sugar-corn are grown between the rows. The coffee-plant usually begins to bear at the fourth year from the nursery, or the fifth or sixth year from the seed. The tree is supposed to reach its prime at ten years old, becomes practically sterile at twenty, and may by care be kept in bearing for forty years. The extremes of the flowering season are from August to January. The berry begins to form in November, and to ripen in April or May, when the harvesting begins. This is done by hand, and generally very carelessly. The berries are washed, dried, and put through various processes of cleaning for the market; what is called "washed" coffee is put through a different process, in which much of the treatment is given under water.

Object-Studies in Botany.—Prof. Bessey some time ago urged teachers of botany to give a more intelligent direction to the collections which their pupils will make during the season of study. The usual course is to gather a surplus of the showy flowers which are the most easily studied, and neglect the others, of which less is known. The teacher should take special pains to point out the features of interest in the funguses, etc., which the student may bring in. Let him direct attention to the pores, on the walls of which the spores are developed — to the closely interwoven threads of the body of the fungus. When a spotted strawberry-leaf is brought in, let him tell something, if it be but little, about the cause of the spots; and let the pupil be taught to look for similar spots on other plants, and to study them. Do so with lichens, with pond-scums, with green slimes, with mosses, with liverworts—in fact, with whatever is brought in by the sharp-eyed young collector. "He must be a poor teacher indeed who can not suggest something to his pupil about a toadstool or a puff-ball. It is not necessary to know the species or even the genus to which a plant has been assigned in order to be able to make valuable suggestions to one's pupils."

Contributions to the Geology of Staten Island.—Dr. N. L. Britton has reported to the Natural Science Association of Staten Island concerning observations that lead him to consider that the serpentine and talcose rocks forming the main ridge of the island were derived from magnesian limestone and hornblende or tremolite strata. The rocks were doubtless originally deposited in a conformable sequence, but the serpentines were left on top in the folding of the strata. The hypothesis of a southwestward extension of the crystalline rocks across New Jersey has been confirmed in a well-boring at Perth Amboy. Considerable additions to the fossil

flora have been obtained by Mr. Hallick from the ferruginous sandstone on the shore at Tottenville. The occurrence of copper, derived from the decomposition of pyrites, in the limonite ore beds at Todt Hill is mentioned. Several well-defined nearly driftless areas north and west of the terminal moraine illustrate an interesting feature of glaciation.

NOTES.

PROF. D. S. MARTIN'S Geological Map of New York City and its Environs is the only map giving in detail the geology of the entire region (fifty-five by sixty-eight miles) surrounding the metropolis; it is compiled with great care from separate sources, some of which are not easily accessible, and some are unpublished; it exhibits the relations of many geological systems and series east of the Alleghanies; and shows striking features connected with the Glacial age, the terminal moraine, and the ancient (now submerged) channel of the Hudson River. A pamphlet of explanations accompanies every copy. A few copies of the second edition of the map still reman for disposal at ten dollars each. No more are likely to be published. Address Prof. Martin, at Rutgers Female College, West Fifty-fifth Street, New York.

MR. C. R. ORCUTT remarks, in the West American Scientist, on the prominence of the great variety in rock-lichens in producing a pleasing effect in the scenery of Lower California. Red, yellow, gray, and white are the prevailing colors, and the whole side of a cliff is often covered by lichens of the same tint. Quartz, however, is not a favorite rock with the lichens, and consequently is seldom concealed. The lichens frequently imitate, in coloring, the natural hue of the rocks on which they are found.

A BOOK by Mr. George F. Kunz, the distinguished mineralogical expert of the house of Tiffany & Co., on the Gems and Precious Stones of North America, is announced for publication by the Scientific Publishing Company, New York. It will be a popular description of the occurrence, value, history, and archæology of precious stones in America, and of the collections in which they exist, with a chapter on pearls. The several species and varieties are described systematically. The work will be sold at ten dollars a copy.

MR. JOHN GRIFFITT, of Smyrna, has reported favorably on the results of a season's experiments in rearing silk-worms on mulberry-trees, under muslin screens, in the open air, using the regenerated Bournabat *graine*. They show that the regeneration was thorough and complete, enabling the worms to endure the low temperature of 45° F., with storm and wet for ten consecutive days. The proportion of *satiné* or satin-like cocoons was extraordinary—fifty to two hundred and ninety-four in all. A somewhat similar trial made in India some years ago was successful experimentally but not financially. In this case the worms, under calico screens, ate along the hedge at their will, new relays taking the place of the old ones as the parts of the hedge over which they had eaten recovered their leaves.

RIVER water was substituted for spring water in one of the quarters of Paris several times last summer. In every instance, according to the "Semaine Médicale," an increase of typhoid fever was observed. The quantity of spring water brought to Paris being insufficient for the demand, the Council of Public Hygiene and Health has determined to expedite the labors for the new supply from springs recently bought by the city, and to insist that the use of the present spring waters be limited to food purposes.

HENRY HOLT & Co. will publish soon, Introduction to Systematic Botany. By Charles E. Bessey, professor in the University of Nebraska, and author of Bessey's Botanies in the American Science Series.

M. DE MALARCE recently informed the French Academy of Sciences that the use of the metric system had in 1887 become compulsory in countries having an aggregate population of 302,000,000, being an increase of 53,000,000 persons obliged to use it in ten years; use was optional in countries having nearly 97,000,000 inhabitants; and was legally admitted and partially applied in countries having an aggregate population of 395,000,000. The systems of Japan, China, and Mexico are decimal but not metric. Hence the metric system is legally recognized by 794,000,000 people and decimal systems by about 474,000,000 others.

BY the Hungarian trade law of 1884, every commune in which there are fifty or more apprentices must provide for their education, and afford special courses of instruction. The apprentice schools in Buda-Pesth contain a preparatory class, provide a course of three years, and are chiefly designed to educate apprentices for the higher trade schools. Each district of the town must have at least one apprentice school. No class is to have more than fifty or at most sixty pupils. Deserving pupils are promoted at the end of each year. In the other towns and counties of the kingdom there are 229 apprentice schools, with 1,237 teachers and 38,081 pupils.

THE Swedish Oyster-culture Society is trying to acclimatize American oysters from Connecticut on the coast of the province of Bohus. The young oysters seem to thrive well.

A SCHEME of the French Government to encourage the intermarriage of life-convicts in New Caledonia with life-convicts imported from the prisons at home is pronounced mischievous by the "Lancet." The purpose is to build up family relations in the interest of morality; but British experience is to the effect that such alliances lead to the multiplication of criminals, and that the real check to crime lies in breaking up and isolating the criminal class. Testimony gleaned by M. Louis Barron from the journals of New Caledonia points in the same direction, and forms an instructive commentary on the law of heredity as deduced by Darwin.

THE French fishermen are troubled by the depredations of porpoises, for which they have not succeeded in finding a remedy. An attempt was made to catch them in seine nets, but they jumped out of the snares. They were scared away by guns and torpedoes, but the fish were frightened and disappeared with them. They are too numerous to be shot one by one in an effective manner. The only thing to be done seems to be for the fishermen to unite and drive them away in crowds; but this will have to be often repeated. Insurance and payment of damages by the Government are the last measures of relief suggested; but they, too, are expensive to somebody.

VANILLA is produced from a species of orchid that attaches itself to walls, trees, and other suitable objects. The plant has a long, fleshy stem, and the leaves are alternate, oval, and lanceolate. The flower is of a greenish-white color, and forms axillary spikes. The fruit is a pod, measuring when full grown some ten or twelve inches in length and about half an inch in diameter. The quality of the pod can be determined by the presence or non-presence of a crystalline efflorescence called *givre*, and by its dark chocolate-brown color. The fragrant *givre* is *vanillin*, $C_8H_8O_3$. The pods also contain vanillic acid, oily matter, soft resin, sugar, gum, and oxalate of lime.

A STRIKING example of degeneration in growth is exhibited by the scale that attacks greenhouse and other plants. According to Mr. Bernard Thomas, in "Science Gossip," it is a degenerated female which lives upon the sap of the plant, continuing to increase in size and reproduce its young. These may be found underneath it as minute red bodies, just visible to the naked eye, and at this time of their life comparatively active creatures; but they soon settle down and begin to degenerate. Their eyes become indistinct, and finally, with their antennæ and legs, shrivel away, the body loses its thickness, and they appear as if without life.

TOTEMS are defined by Mr. J. G. Fraser as "a class of material objects which a savage regards with superstitious respect, believing that there exists between him and every member of the class an intimate and altogether special relation." They are tribal emblems, family symbols, signals of nationality, expressions of religion, bonds of union, and regulators of marriage-laws and of the social institutions. The system of totems exists among most primitive peoples, and in similar forms with the North American Indians, Australians, South Africans, Arabs, hill tribes of India, Polynesians, and many other peoples. Among a tribe in Colombia, where descent is in the female line, it goes so far that if a man happens to cut himself with his own knife, to fall off from his own horse, or to hurt himself in any way, his mother's clan demand blood-money from him for injuring one of their totems.

OBITUARY NOTES.

PROF. VAN QUENSTEDT, of Tübingen, one of the most famous of German paleontologists, died December 21st, at an advanced age. He was the author of a work on the Jura, and of a Handbook of Petrefactenkunde, or the science of petrifactions. He had an especially profound knowledge of the Lias of Würtemberg and its fossils.

M. CH. FIEVEZ, assistant in the spectroscopic department of the Royal Observatory of Brussels, died February 2d, aged forty-five years. He studied first for the military profession, but was invited to the observatory by M. Houzeau, and entered it after studying under Janssen at Meudon. His most important work was the construction of a chart of the solar spectrum on a larger scale than that of Angström. He made a detailed study of the spectrum of carbon, and experiments on the behavior of spectral lines under the influence of magnetism and of changes of temperature.

DR. C. C. PARRY, a distinguished American botanist, recently died at Davenport, Iowa, aged sixty-seven years. He made valuable collections of plants, and was an authority in the classification of the North American flora. He was for several years a botanist in the Agricultural Department in Washington. Mount Parry, near Denver, was named after him.

PROF. RICHARD OWEN, geologist, died from accidental poisoning at his home in New Harmony, Ind., March 24th. He was a son of the Scotch philanthropist, Robert Owen, and was born in Scotland, January 6, 1810. Having been schooled in Europe and come to the United States, he studied civil engineering in Kentucky, was a Professor of Geology there, served in the United States Survey, was a captain in the Mexican War, was State Geologist for Indiana, professor in Indiana State University, and lieutenant-colonel and colonel in Indiana volunteer regiments.